OVERSIGHT

METHANE TRANSPORTATION R. & D. ACT OF 1980

HEARING

BEFORE THE

SUBCOMMITTEE ON TRANSPORTATION,
AVIATION AND MATERIALS

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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OVERSIGHT ON METHANE TRANSPORTATION R. & D. ACT OF 1980

THURSDAY, NOVEMBER 19, 1981

House of Representatives, Committee on Science and Technology, Subcommittee on Transportation, Aviation and Materials,

Washington, D.C.

The subcommittee met, pursuant to call, at 9:35 a.m., in room 2325, Rayburn House Office Building, Hon. Dan Glickman (chairman of the subcommittee) presiding.

Present: Representatives Shamansky, Dunn, Carney.

Also present: J. Jeffrey Irons, minority technical consultant and Curt Stanford, research assistant.

Mr. **Glickman**. The committee will come to order. Under the committee rules, I will ask if there's objection to any photography or recording of the proceedings. And hearing none, it may be permitted.

Today the Science and Technology Committee on Transportation, Aviation, and Materials, will consider the Department of Energy's progress to date on the Methane Transportation Research, Development, and Demonstration Act of 1980 and their plans for implementation of that act.

This act provides for advanced and accelerated research and development of methane-fueled vehicle design and related technologies, and for the facilitation and removal of barriers to the use of methane-fueled vehicles as an alternative to gasoline or diesel-powered vehicles, where practicable.

For the benefit of those who may need some clarification regarding methane, what we're really talking about is natural gas as a motor fuel.

With our continued dependence on foreign oil, the importance of methane as a fuel must not be overlooked. The United States continues to be dependent upon OPEC for about 35 percent of our oil, resulting in a cost of $50 billion a year or more for oil imports. This dependence on unstable foreign governments is a very serious matter and I believe a potential threat to our national security. Yet, we have not placed a high priority on the use of alternative fuels, and in fact, I think we are now moving in an opposite direction.

In a recent interview, Sheik Yamani of Saudi Arabia candidly admitted that their production of the current international oil glut was a conscious policy designed for the purpose of making the United States and other industrial nations reluctant to implement alternative energy projects. For the record I'd like to include a statement Sheik Yamani made on January 31, 1981, at the University of Petroleum and Minerals in Dhahran, Saudi Arabia. He said:

> Saudi Arabia's interest may appear to be served by lower production rates and higher prices, irrespective of the outcome. Let me remind you of my earlier statements regarding the link between price and consumption rates. Whenever prices go down, consumption goes up, and vice versa. Whenever oil prices increase, large amounts of capital are invested in search of alternative sources of energy and in a search for oil in different areas. If we force Western countries to invest heavily in finding alternative sources of energy, they will. This would take no more than seven to ten years and would result in reducing dependence on oil as a source of energy to a point which will jeopardize Saudi Arabia's interest.

If you've ever heard similar warnings by American politicians, it could not have been said more clearly by Sheik Yamani. And I think the Saudi strategy has been largely successful. In fact, here in the United States we are now considering a proposal to abolish the Department of Energy entirely because, I think, of a feeling that oil will be here forever and the glut will continue forever.

Yet, we have at our fingertips an alternative fuel that is cheaper than gasoline and is readily available right now. Of all the alternative fuels being discussed, methane or natural gas shows the most short- and long-term promise, particularly for use as a motor fuel. If we converted 1 million vehicles to methane fuel, we would reduce U.S. consumption of petroleum by nearly 300,000 barrels a day, or nearly 100 million barrels annually by 1990.

At this time I would like to ask my colleague from Ohio, Congressman Shamansky, if he has any comments.

Mr. **SHAMANSKY**. My comment, Mr. Chairman, is to say "amen" to what you have just said so well, and I am sure that we are all interested in getting ourselves less dependent or totally nondependent on the OPEC countries. Thank you.

Mr. **GLICKMAN**. Thank you. I would first like to welcome as our first witness today Dr. Patrick McGeer who was kind enough to come from British Columbia to help with this hearing today. Dr. McGeer is Minister of Universities, Science, and Communication, with the British Columbia Parliament. In addition to that, he is a noted physician. I believe you're a neurosurgeon?

Dr. **MCGEER**. Neuroscientist.

Mr. **GLICKMAN**. Neuroscientist. But you are a physician?

Dr. **MCGEER**. Yes.

Mr. **GLICKMAN**. You've been involved in international medical research and I understand you've been instrumental, in pushing your government, both the British Columbia Government and the Canadian Government, into an active role in developing a variety of alternative energies, particularly natural gas or methane as a motor fuel. I look forward to hearing your testimony.

I might mention for the record, the House goes in at 10 today. Bells will start ringing and we have to interrupt these hearings to run over to the House floor and vote.

We have a total of four witnesses, and I think that we ought to be able to be finished, if possible, by noon. I might also mention that all the witnesses' entire statements will be included in the record if they so desire. So you may feel free to summarize where you deem appropriate.

I notice that my colleague, Mr. Dunn from Michigan, has arrived. Michigan is a State that relies, of course, more than most on the production of automobiles and we're glad to have you here. Do you have any comments?

Mr. **Dunn**. I don't have any opening remarks. Thank you.

Mr. **Glickman**. Thank you. Dr. McGeer, why don't you begin?

STATEMENT OF HON. PATRICK L. McGEER, MINISTER OF UNIVERSITIES, SCIENCE AND COMMUNICATIONS, GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

Dr. **McGeer**. Thank you, Mr. Chairman. For the members of the committee, I appear as a member of our British Columbia Cabinet. The views I express, of course, are my own. I hope that they will properly reflect the programs that are taking place in British Columbia and in Canada, but they don't necessarily represent the views of either government.

May I begin by describing the specific things that we have done in British Columbia to relieve ourselves of a dependency upon OPEC. We have investigated the alternatives that we might find and in our view methane or natural gas is so far superior to any alternative that is available in British Columbia, in Canada, or in North America, that it does not merit at this time serious pursuit of the other possibilities.

We have commenced in our Province, therefore, to begin implementing a program of conversion of the transportation fleet to methane commencing with a research program in our Province. My own ministry car was the first to convert to methane. We have sponsored a major program at the University of British Columbia to investigate the technological aspects, so we would have a good grasp of the state of the art in the world. We have followed this up with a conversion to methane of a government-owned fleet, the B.C. Hydro fleet, which is our gas and electric company. This is being followed up with the first conversion of a private fleet, Blacktop Cabs, the largest cab company in British Columbia, which is now being converted. The first public service station will be opened in British Columbia about the end of the year, complete with the first training center for mechanics, and therefore the first place where the general public will be able to get their cars properly converted.

During 1982 a more broadly based program will commence in British Columbia, where information will be given to the public. They will be actively encouraged, and incentive programs will be introduced by the Provincial government.

Why is this being done in British Columbia? Well, gentlemen, we're politicians and we think that this is good politics and good commonsense. We think so because it's one of these circumstances where everyone can win.

First of all, the motorists can win because they have an opportunity to drive their automobile on a much cheaper fuel. Not only that, but there is a reliability to that fuel because we possess it in abundance in North America, particularly in the western part of Canada. But certainly, methane or natural gas is here in adequate supply now and into the future. And I would debate with any individual the validity of that statement.

So people then who have methane as the fuel for their car have been given an added dimension, that is, a fuel that is cheaper and reliable, while not giving up the fuel that they run on now, namely, gasoline. In other words, we're encouraging dual fuel.

Second, the gas company wins because an automobile converted to natural gas uses about the same amount of fuel in our climate as does a three-bedroom home. So the gas company, then, if a fleet of cars is converted, has the equivalent of a subdivision. But with one difference: Instead of having to pay about $2,000 a home to hook up and to put in a gas meter and to have servicemen for every home in that subdivision, one meter, one pipeline, and therefore the overhead costs for the dispensing of the methane go way down. Indeed, some gas companies in the United States have told us that because of conservation measures their gas sales are going down, and as they go down their overhead stays constant. So they have no choice but to increase the cost to the consumer.

If automobiles are converted, the maintenance of this enormous network that you have in the United States of a million miles of pipeline can partly be carried by the automobiles that convert.

Third, the people who don't convert their cars gain because there is far less pollution. Most people, when you talk about methane or CNG don't realize that what you're talking about is the same fuel that they burn in their furnaces and cook with in their stoves. So, in theory you could operate your automobile right in the living room. Of course people don't do that, but they certainly wouldn't think of operating a diesel car or a gasoline car or a bus in their living room.

But the fact that methane is such a clean-burning fuel means that if many people convert, much of the pollution caused by automobile exhaust in our cities will disappear.

Finally, and most importantly for serious legislators is the fact that the country gains. In our nation we are subsidizing oil from OPEC to the extent of about $20 a barrel. And since one can get about 20 gallons of gasoline out of a barrel, then we are subsidizing automobiles to the extent of about a dollar a gallon for the gas, keeping it mind that it's the final one-third of our automobiles that are really the ones that are using the OPEC gasoline. And therefore I have said, partly as an outrageous statement to provoke people, that we would be better off in Canada bringing in foreign automobiles that burned only methane and giving them away to the consumers than we are buying automobiles made in Canada that were committed to OPEC fuel. The reason is that, over the lifetime of a car, the value of the fuel that the car burns is greater than the value of the steel and the other components that are in the car itself.

So that when one thinks of automobiles, whether it's in the United States or Canada, one must think in terms of their assets or liabilities with respect to the fuel as being more important than the steel and the tires and all the other components.

Why is more not happening with respect to using methane as a dual fuel in cars? It's because there is a financial threshold between the utilization of the methane technology, and the supply of the fuel both of which are available, and the application to the automobile fleet. The problem is that the automobiles have not been manufactured to run on this fuel and therefore people have to be like car doctors. They have to perform an operation and cure a congenital defect in the automobile before it can use the good and the available fuel, methane. That operation costs money, about $1,500 per automobile.

Second, even after the automobile is converted, this new fuel has got to be somewhere where that motorist can utilize it. He's got fueling stations all over North America where he can get gasoline, but not where he can get compressed natural gas or methane. And therefore we've got to supply the pumping stations, so that if he spends the $1,500 curing this congenital defect in his car, he'll be able to use it regularly and make use of that fuel.

In order for this to happen, in our view, in British Columbia, it will be necessary initially to give incentives to service stations to install the compressing equipment, because until they are assured of several hundred cars coming in to use their fueling station, they are going to lose money on that equipment. Then we need to provide incentives to the first people in order to convert their car, because they are the ones that are taking the initial risk. They can only recover the cost of that initial investment by running their car for a long period of time on that fuel to pay off the conversion cost. And of course, the only way that the service stationman can recover his investment is if a lot of automobiles use his facility.

So the way government participates, the way government leads, the way government acts as a catalyst; is to overcome this threshold, first of all, by giving the necessary incentives to the leaders in the field, be they those that supply the fuel or those that convert their cars, in order to provide that infrastructure that then will make it easy for everyone to follow.

In my opinion the larger context of this whole fuel crisis issue is to restore a balance or a symbiosis that has grown up over the past three-quarters of a century between the automobile manufacturers on the one hand, the fuel suppliers on the other, and the consumer that makes use of them. Governments have worked their way in between this triad, they're the ones that build the highways, provide the incentives, levy the taxes. And because there has been a balance it has been possible for the transportation companies, the automobile manufacturers and the fuel companies, to have some of the largest corporations in the history of the world.

Now, OPEC has thrown all of that out of balance. The tribute paid to OPEC nations by the United States is some $90 billion a year to countries with tiny populations who are unable to absorb that money. In turn, these nations recycle that money back through Europe, but that's out of the control of your Federal Reserve System. That money consists of your dollars. Nobody has control of the American dollar any longer, nor any world currency, and this fuels inflation. People can't understand the relationship between the price of bread in the supermarket and the inflation that is caused by the transfer of these dollars to OPEC, and their recycling back through systems where there is no central reserve control over the supply.

What do you do in the United States to try and recover that? One way is to send arms to the Middle East and bring some of that money back through arms sales. Another way is to raise interest rates so that the dollars are repatriated to the United States. But both of these methods cause their own internal difficulties, as you know. One of the consequences is that the automobile manufacturers can't sell their cars. First of all, they don't know what the consumers want anymore. Second, the inflation rate prevents people from buying the cars. So suddenly it becomes necessary to lay off automobile workers.

What happens then? Well, the automobile workers can't buy refrigerators. And suddenly we've got an escalating depression because we have broken this circle of confidence and of balance on which the economy depends between car manufacturers, fuel manufacturers, and consumers. OPEC will never permit any nation to recover that balance. It can only happen when adequate supplies of a substitute fuel are available so that we no longer need OPEC oil. That is the major objective. And when one no longer needs OPEC oil, one can then give confidence to the public by setting in place long-range pricing objectives. Then consumers know they are going to get the fuel, they know what price they are going to have to pay, they know what sort of car they are going to want to buy, they know what the taxes will be. Therefore, the car manufacturers will be able to predict what should be done, the fuel companies will be able to predict what their capital structure should be and what their supply should be like, and we'll begin to restore some balance to the economy again.

My fear as an individual is that the imbalance has grown to the point where we may not be able to recover, that the escalation of unemployment, the collapse of some of the major industries of North America and the world, will bring us to the brink of a depression. So I consider in the larger context the supplying of an alternative fuel, the development of a secure program, is important to the overall economies of all of the Western nations.

Many people talk about LPG, liquid propane gas, and this is being pursued as an alternative fuel. But gentlemen, the problem with that is that there is not enough propane in North America to operate the automobiles that now exist in the city of Chicago, much less the North American continent. So while that has some limited and short-term attractiveness, it cannot possibly solve the larger problem.

So it is our hope, my hope for British Columbia, that people will pay a great deal of attention to the necessity of developing alternative fuels and that the timeframe for that will be short. At the very least we've got a world inflation problem to deal with. At the worst, we'll face disruption in the Middle East and an absolute limitation on supply, which in itself will have to cause a major readjustment of the industrial structure.

I have just come back from South America where they are pursuing an active program of substituting ethanol for oil. They have produced automobiles that will run exclusively on ethanol. Most of the gasoline they sell is gasohol, and they have made some progress. But I can give you the relative figures, as we see them, for

North America, with respect to ethanol and other alcohols, gasoline, and methane.

For the average car that might run 25 miles a day, it would cost, by our figures, about $3.80 to run on ethanol, $2.20 to run on methanol, $1.80 to run on gasoline, and about 90 cents on methane. There is such a spread between what it would cost to make ethanol from biomass as compared with methane, which is available in generous supply, that it would not appear to us that this is a viable major alternative to pursue at the present time.

[The prepared statement of Minister McGeer follows:]

A GLOBAL STRATEGY FOR INTRODUCING METHANE AS A MOTOR VEHICLE FUEL

REMARKS BY

THE HONOURABLE PATRICK L. MCGEER
MINISTER OF UNIVERSITIES, SCIENCE AND COMMUNICATIONS
GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

TO

SUBCOMMITTEE ON TRANSPORTATION, AVIATION
AND MATERIALS
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

NOVEMBER 19, 1981

IN 1973 THE OPEC NATIONS SERVED NOTICE UPON THE REST OF THE WORLD THAT THEY NO LONGER INTENDED TO SUPPLY OIL AT WHAT THEY CONSIDERED TO BE THE BARGAIN BASEMENT PRICE OF $1.80 A BARREL. THEY SAID THEY WERE GOING TO INCREASE PRICES AND THAT WESTERN EXPLOITATION OF THE VAST FIELDS OF THE MIDDLE EAST HAD TO BE REDUCED.

THE OPEC NATIONS HAVE CERTAINLY DELIVERED ON THEIR WARNING. WORLD OIL PRICES HAVE INCREASED TWENTYFOLD SINCE THAT DECLARATION OF EIGHT YEARS AGO. WHILE THE PRODUCTION OF OIL IS STILL ADEQUATE TO MEET WORLD NEEDS, ALLOCATION IS UNCERTAIN, AND ANXIETY PREVAILS. THE MIDDLE EAST IS ONE OF THE LEAST STABLE POLITICAL AREAS IN THE WORLD AND CANADA AND THE UNITED STATES ARE DEPENDENT ON IT FOR OIL. THE FOREIGN POLICY OF EVERY OIL-SHORT COUNTRY IN THE WORLD HAS BEEN REASSESSED AS EACH TRIES TO ENSURE ITS SECURITY OF SUPPLY. THE ARAB NATIONS, ADJUSTING TO THEIR VAST NEW RICHES, BUT UNCERTAIN IN POWER, HAVE OFTEN RESPONDED IN UNPREDICTABLE WAYS TO THE PRESSURES OF WORLD POWER POLITICS. BUSINESSMEN AND CONSUMERS IN THE PRIVATE SECTOR OF WESTERN NATIONS HAVE BECOME CONFUSED. THEY WORK WITHIN THE FRAMEWORK OF WORLD POLITICS BUT HAVE LITTLE INFLUENCE OVER THEM. NEVERTHELESS ECONOMIES MOVE BECAUSE OF THE SUM TOTAL OF THEIR INDIVIDUAL PRIVATE SECTOR DECISIONS. IF THEY ARE UNABLE TO PLAN LOGICALLY FOR THE FUTURE, NATIONAL ECONOMIES STUMBLE FOR REASONS THAT SEEM TO DEFY EXPLANATION.

TOTAL PAYMENTS TO MIDDLE EAST NATIONS FROM OIL CONSUMING NATIONS RUN AT A RATE APPROACHING $700 MILLION A DAY. THE UNITED STATES ALONE NOW SPENDS SOME $80 BILLION A YEAR ABROAD FOR OIL. THESE PAYMENTS HAVE BEEN ONE OF THE MAJOR DRIVING FORCES BEHIND WORLD INFLATION, AND THE PRINCIPAL CONTRIBUTOR TO WORLD FINANCIAL UNCERTAINTY.

FOR THIRD WORLD NATIONS THE CONSEQUENCES HAVE BEEN NOTHING SHORT OF TRAGIC. UNABLE TO POWER THEIR MACHINERY, THEY SINK FARTHER BEHIND THE WEST, ACCUMULATING POLITICAL PROBLEMS FOR THE FUTURE.

THE REFLEX REACTION OF WESTERN NATIONS HAS BEEN TO HUNT FOR ADDITIONAL SUPPLIES OF CONVENTIONAL OIL WHILE PREACHING CONSERVATION. SOME SUCCESS HAS BEEN ACHIEVED, BUT NOT NEARLY ENOUGH TO OFFSET A DANGEROUS DEGREE OF DEPENDENCY ON OPEC NATIONS. THE ONLY NOVEL AND APPROPRIATE APPROACH HAS BEEN THE SEARCH FOR ALTERNATIVE FUELS TO GASOLINE AND DIESEL. IT IS HERE WHERE THE RESPONSE SHOULD HAVE BEEN SWIFT AND DEFINITIVE, BUT WHERE IT HAS BEEN MARKED BY DOUBT AND CONFUSION, INCOORDINATION AND INEFFECTIVENESS.

3./

WHILE OIL IS USED FOR MANY PURPOSES, ITS HIGH ENERGY DENSITY, ESSENTIAL FOR TRANSPORTATION, IS THE REALLY PRESSING PROBLEM. ALTERNATIVES ARE NOT THERE AND THE PRICE DEMAND IS INELASTIC. ALTHOUGH HITLER'S TANKS AND MESSERSCHMITTS RAN ON FUEL MADE FROM COAL, THAT TECHNOLOGY HAS ADVANCED LITTLE SINCE WORLD WAR II. IMMEDIATELY AFTER THE WAR, GERMANY WAS FORBIDDEN TO REBUILD ITS COAL LIQUEFACTION PLANTS. BY THE TIME THE EMBARGO WAS LIFTED, MIDDLE EAST OIL WAS FLOODING EUROPEAN MARKETS AND THE TECHNOLOGY SLIPPED INTO LIMBO. ONLY ISOLATED SOUTH AFRICA PURSUED COAL LIQUEFACTION AND TODAY THEIR SASOL PLANTS ARE THE ONLY MAJOR FACILITIES IN THE WORLD CAPABLE OF PRODUCING LIQUID FUELS FROM COAL. BRAZIL IS MOVING TO MAKE ETHANOL FROM SUGAR CANE AND THUS TO FIND, IN THE LONG TERM, ITS OWN UNIQUE SOLUTION.

SO FAR, NORTH AMERICA HAS DONE LITTLE. IN CANADA, A COUPLE OF TAR SANDS PLANTS HAVE BEEN BUILT, BUT FURTHER PROGRESS HAS BEEN SHELVED PENDING THE OUTCOME OF THE FEDERAL/PROVINCIAL ENERGY DISPUTE. SOME COAL LIQUEFACTION PILOT PLANTS ARE IN OPERATION IN THE UNITED STATES. A LITTLE GASOHOL IS BEING USED, AND SOME VEHICLE CONVERSIONS TO LIQUID PROPANE GAS ARE TAKING PLACE. BUT AT LEAST TEN YEARS WILL BE REQUIRED FOR ANY OF THESE ALTERNATIVES TO HAVE ANY SUBSTANTIAL IMPACT ON THE NEED FOR GASOLINE AND DIESEL FROM OIL.

4./

IF WE DO NOTHING, THE PROBLEM WILL NOT GO AWAY. WE WILL REMAIN DEPENDENTS OF OPEC NATIONS. OUR MIGHTY TECHNOLOGY WILL NOT MAKE US FREE. WE WILL BE SUBJECT, IF OPEC NATIONS CHOOSE, TO POLITICAL BLACKMAIL. ONLY LAST WEEK, THERE WAS A MEETING IN KUWAIT TO CONSIDER CUTTING OFF OIL TO THE U.S. AS A RESULT OF THE ISRAELI AIR STRIKE AGAINST IRAQ'S NUCLEAR POWER PLANT. WHILE THAT PROPOSAL WAS NOT ACTED UPON, IT SIGNIFIES THAT POLITICAL INSTABILITY WILL PERSIST.

ENORMOUS AND UNPRODUCTIVE TRANSFER PAYMENTS WILL CONTINUE TO BE MADE. POOR NATIONS WILL GET POORER. AND EVEN GREAT INDUSTRIAL NATIONS LIKE THE UNITED STATES WILL SUFFER AS ITS BEWILDERED AUTOMOTIVE COMPANIES HAVE DISCOVERED. BETTER SOLUTIONS ARE NEEDED.

KNOWING THE MAGNITUDE AND URGENCY OF THE PROBLEM, WHAT WOULD YOU SAY IF YOU WERE TOLD THAT THERE WERE ADEQUATE DOMESTIC SUPPLIES OF THE PERFECT ALTERNATIVE FUEL AVAILABLE NOW ?

WHAT WOULD YOU SAY IF YOU WERE TOLD THAT THE FUEL WAS SAFER THAN GASOLINE ? WHAT WOULD YOU SAY IF YOU WERE TOLD THE FUEL HAD A HIGHER OCTANE VALUE THAN GASOLINE ?

WHAT WOULD YOU SAY IF YOU WERE TOLD THAT THE FUEL WAS SO CLEAN THAT YOU WOULD BURN IT IN YOUR OWN HOME AND THAT IF IT WERE UTILIZED IN AUTOMOBILES IT WOULD REDUCE TREMENDOUSLY THE SMOG THAT OCCURS IN OUR LARGE CITIES AS A RESULT OF AUTOMOBILE EXHAUSTS ?

WHAT WOULD YOU SAY IF YOU WERE TOLD THAT THIS FUEL MADE ENGINE STARTING EASIER, PARTICULARLY IN COLD WEATHER ? WHAT WOULD YOU SAY IF YOU WERE TOLD THAT IT WOULD PERMIT YOU TO DRIVE MUCH FARTHER WITHOUT CHANGING OIL, OR SPARK PLUGS, OR OVERHAULING YOUR ENGINE ?

WHAT WOULD YOU SAY IF YOU WERE TOLD THAT THE FUEL DIDN'T NEED TO BE REFINED, AND COULD BE DELIVERED NOW, NOT JUST TO YOUR CORNER SERVICE STATION, BUT RIGHT INTO YOUR OWN HOME ?

WHAT WOULD YOU SAY IF YOU WERE TOLD THAT THE FUEL WAS CHEAPER THAN GASOLINE, IN MY PROVINCE OF BRITISH COLUMBIA ONLY ABOUT 1/6TH OF THE COST ? WHAT WOULD YOU SAY IF YOU WERE TOLD THAT IN MANY PARTS OF THE WORLD, IT IS CONSIDERED AN ANNOYING BY-PRODUCT AND IS SIMPLY BURNED OFF AND WASTED RATHER THAN CAPTURED AND USED ? WHAT WOULD YOU SAY IF YOU WERE TOLD THAT IF ALL AUTOMOBILES USED THIS FUEL, NOT A DROP OF IMPORTED OIL WOULD EVER BE REQUIRED AGAIN IN THE UNITED STATES OR CANADA ?

6./

WOULDN'T YOU SAY, IF ALL THOSE THINGS ARE TRUE, THEN AREN'T WE FOOLS NOT TO SUBSTITUTE THIS FUEL FOR GASOLINE NOW ? SHOULDN'T WE REQUIRE IT, IF ONLY ON THE GROUNDS THAT IT WILL FREE US FOREVER FROM THE POSSIBILITY OF POLITICAL BLACKMAIL OR ANY OTHER PRESSURE FROM OPEC NATIONS.

REMEMBER THAT A NATION IS NOT REALLY IN CHARGE OF ITS OWN DESTINY IF A LESSER NATION CAN SAY "DO WHAT WE ADVISE OR WE WILL CUT OFF YOUR OIL."

LADIES AND GENTLEMEN, I HAVE, OF COURSE, BEEN REFERRING TO METHANE, AND ALL THE THINGS I HAVE SAID ARE TRUE. THAT IS UNDOUBTEDLY KNOWN TO ALL OF YOU HERE TODAY.

METHANE HAS AN OCTANE NUMBER OF 130, FAR ABOVE THAT OF THE GASOLINE WHICH IS BURNED IN OUR VEHICLES TODAY. IT IS SO CLEAN AND NON TOXIC WE DO NOT HESITATE TO BURN IT IN OUR KITCHENS FOR COOKING. IT PROLONGS THE LIFE OF AUTOMOBILE ENGINES. IT DOES NOT DILUTE THE LUBRICANT. IT IS MUCH BETTER FOR THE ENVIRONMENT. SINCE IT IS A GAS EVEN AT LOW TEMPERATURES, IT MAKES ENGINE STARTING EASIER. IT HAS A HIGH IGNITION TEMPERATURE AND A NARROW FLAME LIMIT AND THEREFORE IS A LESSER FIRE OR EXPLOSION HAZARD THAN GASOLINE.

7./

IT IS LIGHTER THAN AIR, AND UNLIKE PROPANE WHICH PUDDLES WHEN RELEASED, IT RISES AND QUICKLY DISPERSES WHEN IT ESCAPES. OVER ONE MILLION MILES OF PIPELINE DELIVER IT TO THE MAJORITY OF HOMES IN NORTH AMERICA AND COULD DELIVER IT TO ALMOST EVERY SERVICE STATION.

DESPITE ALL OF THIS, EFFORTS TO USE IT HAVE BEEN SO RETARDED THAT SIGNIFICANT AMOUNTS SIMPLY GO TO WASTE.

FOR INSTANCE, IN 1980 ALONE 7.5 TRILLION CUBIC FEET OF METHANE WAS FLARED BY OIL COMPANIES AROUND THE WORLD: EQUIVALENT TO MORE THAN 50 BILLION GALLONS OF GASOLINE.

THAT FIGURE REALLY HITS HOME WITH ME WHEN I CONSIDER THAT BRITISH COLUMBIA, A GAS RICH AREA, HAS ONLY PRODUCED 6.2 TRILLION CUBIC FEET IN ITS ENTIRE HISTORY. MORE METHANE IS FLARED EVERY YEAR THAN WE HAVE EVER PRODUCED IN MY OWN PROVINCE! MOST OF THIS NATURAL GAS IS FLARED IN THE MIDDLE EAST, OF COURSE, BUT OTHER JURISDICTIONS ARE EQUALLY IRRESPONSIBLE. IN INDONESIA, WHERE THE THREE OILFIELDS OF BADEK, NIHEM AND HANDIL FLARE 300 MILLION CUBIC FEET OF METHANE EVERY DAY, THE FOLLY IS BEING CORRECTED. A PIPELINE TO COLLECT THE GAS AND CARRY IT TO AN LNG PRODUCTION PLANT WHICH WILL BE DOUBLING ITS CAPACITY AND DOUBLING ITS SHIPMENTS TO JAPAN IS NOW BEING BUILT.

8./

THE FLARING FIGURES ARE DISTURBING. BUT SO ARE OTHER FIGURES, WHERE METHANE IS NOT WASTED BUT SHUT IN. IN ALBERTA OVER 7500 WELLS ARE CAPPED. IN BRITISH COLUMBIA AS IN NEW ZEALAND, GOVERNMENTS THAT OFFERED TAKE OR PAY CONTRACTS TO PRODUCERS IN ORDER TO STIMULATE EXPLOITATION NOW HAVE SUCH A CURRENT SURPLUS THAT HUGE AMOUNTS OF MONEY ARE BEING PAID FOR GAS THAT CAN'T BE USED.

IN 1980 OUR B. C. PETROLEUM CORPORATION CONTRACTED FOR 40 BILLION CUBIC FEET OF NATURAL GAS WHICH WAS PAID FOR, BUT SIMPLY COULDN'T BE MARKETED. THAT COST US $30 MILLION. . . AND IT IS ESTIMATED THE FIGURE COULD DOUBLE OR TRIPLE BY THE END OF 1981.

THE TRUTH IS THAT THERE IS A SHORT TERM GLUT OF METHANE IN MANY AREAS. AS A RESULT, OTHER SOURCES OF METHANE HAVE NEVER BEEN SERIOUSLY EXPLORED. METHANE IS THE MAJOR GASEOUS PRODUCT FROM COAL, PEAT, AND SHALE OIL. IT IS ALSO THE MAJOR GASEOUS CONSTITUENT FROM ANAEROBIC DIGESTION OF GARBAGE OR OTHER BIOMASS, AND IT CAN BE PRODUCED FROM WATER, SOLAR OR NUCLEAR ENERGY.

IF ALL FOSSIL FUELS RUN OUT, METHANE IS THE ONLY RENEWABLE, SAFE, HIGH ENERGY-DENSITY FUEL THAT CAN BE MADE AVAILABLE APART FROM HYDROGEN AND POSSIBLY ALCOHOLS. AT THAT, THE ENERGY PER CUBIC FOOT OF HYDROGEN IS LESS

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THAN A THIRD THAT OF METHANE AND AT THE PRESENT TIME, IT IS FAR, FAR MORE EXPENSIVE.

THE QUESTION THEN IS: WHY ISN'T METHANE BEING USED NOW INSTEAD OF GASOLINE? OF COURSE, IT IS IN ABOUT 400,000 VEHICLES AROUND THE WORLD, INCLUDING MY OWN MINISTRY CAR. BUT THAT IS A DROP IN THE BUCKET. THE MAIN REASON THERE ARE NOT MORE AUTOMOBILES OPERATING ON METHANE IS BECAUSE AN ECONOMIC THRESHOLD EXISTS TO ITS USE BY INDIVIDUALS WHICH MUST BE OVERCOME.

TO PUT IT IN THE PARLANCE OF MY FORMER FIELD OF CHEMISTRY, AN ACTIVATION ENERGY IS NEEDED TO START THE REACTION GOING. A THRESHOLD HAS TO BE OVERCOME AT THE INDIVIDUAL LEVEL. JUST AS INDIVIDUAL MOLECULES MUST REACT TO PRODUCE A NEW CHEMICAL PRODUCT, SO MUST EACH ENGINE BE MODIFIED TO USE ANOTHER FUEL. THEREFORE ONE HAS TO TURN AWAY FROM ALL THE GLOBAL CONSIDERATIONS WE HAVE BEEN DISCUSSING AND FOCUS RIGHT DOWN ON THE AVERAGE CAR OWNER. THE STATE CAN ONLY BENEFIT FROM MASSIVE FUEL SHIFTS IF MILLIONS OF CAR OWNERS MAKE A PERSONAL DECISION TO CHANGE. EACH CAR OWNER WHO MAKES A CHANGE MUST GAIN SOME ADVANTAGE BEFORE THE STATE, IN TURN, CAN GAIN.

THE MAJOR HURDLE WHICH INHIBITS A CAR OWNER FROM MAKING A CONVERSION TO METHANE IS THAT THE ENGINE HAS

10./

NOT BEEN DESIGNED TO USE METHANE. A MINOR HURDLE IS THAT THE CAR BODY HAS NOT BEEN DESIGNED TO ACCOMMODATE APPROPRIATE STORAGE SYSTEMS FOR METHANE. TO STORE METHANE ECONOMICALLY IT MUST EITHER BE COMPRESSED ABOUT 200-FOLD INTO A CYLINDER, OR LIQUEFIED THROUGH TEMPERATURE REDUCTION TO -161°C WHICH CONCENTRATES IT 600-FOLD. THEREFORE THE CAR OWNER FACES SUBSTANTIAL COSTS FOR THE ADDITION OF THESE FEATURES.

SUCH SUBSTANTIAL COSTS WOULD NOT OCCUR IF THESE OPTIONS WERE INCORPORATED AT THE FACTORY LEVEL, BUT NO AUTOMOBILE MANUFACTURER TODAY PROVIDES THAT OPPORTUNITY. THEREFORE EQUIPMENT MUST BE ADDED AND CERTAIN ADJUSTMENTS MADE TO THE ENGINE. AT RETAIL SERVICE STATION PRICES, THIS WILL COST, INCLUDING THE STORAGE TANKS AND LABOUR, ABOUT $1500.

THE GAINS TO THE STATE FROM THE CONVERSION ARE IMMEDIATE BUT AS THINGS STAND NOW, NOT TO THE INDIVIDUAL WHO PAYS OUT THE $1500. THE INDIVIDUAL CAN ONLY RECOVER HIS INVESTMENT OVER A PERIOD OF TIME FROM SOMEWHAT LOWER FUEL COSTS AND LOWER ENGINE WEAR. UNDER SUCH CIRCUMSTANCES, CONVERSION ONLY BECOMES ATTRACTIVE TO TAXI OR OTHER FLEET OPERATORS WHERE AUTOMOBILES PUT IN VERY LARGE MILEAGES.

11./

THERE IS AN ADDITIONAL PROBLEM WITH RESPECT TO REFUELLING. UNFORTUNATELY, NO GOOD HOME COMPRESSOR IS ON THE MARKET WHICH WOULD PERMIT AN INDIVIDUAL TO REFUEL AT HIS OWN HOME, AND THEREFORE HE MUST FIND A SERVICE STATION PREPARED TO SUPPLY THE FUEL. SERVICE STATION OWNERS, OF COURSE, ARE NOT GOING TO ESTABLISH REFUELLING STATIONS UNLESS THERE ARE MANY CARS IN THE VICINITY WHO WILL USE THAT STATION AND THEREFORE PERMIT THEM TO RECOVER THE COST OF THE COMPRESSOR EQUIPMENT. A 60-CAR-PER-HOUR STATION CAN COST AS MUCH AS $250,000. THE OPERATOR IS NOT GOING TO MAKE THIS INDIVIDUAL ECONOMIC DECISION UNLESS HE CAN SEE PERSONAL FINANCIAL GAIN FROM DOING IT. ONCE MORE, THE ADVANTAGE ACCRUES TO THE STATE IMMEDIATELY BUT NOT TO THE INDIVIDUAL SERVICE STATION OPERATOR.

THE DIFFICULTIES ARE COMPOUNDED IN JURISDICTIONS SUCH AS BRITISH COLUMBIA, WHERE THE WHOLE BUSINESS OF OPERATING AUTOMOBILES AND SERVICE STATIONS ON COMPRESSED METHANE IS NEW AND UNFAMILIAR AND THERFORE WHERE FIRE REGULATIONS AND OTHER BUREAUCRATIC DECISIONS DELAY DECISIVE ACTION.

TO RETURN TO THE OVERALL BENEFITS TO A NATION OF REGAINING ENERGY INDEPENDENCE, EASING OF POLITICAL INSTABILITY, SAVING OF FOREIGN EXCHANGE, AND IMPROVING

12./

THE ENVIRONMENT, THEY ONLY CAN BE REALIZED IF THE CONVERSIONS ARE UNDERTAKEN ON A MASSIVE BASIS. THEREFORE, FIRM GOVERNMENT LEADERSHIP IS REQUIRED IN ORDER FOR THE PROGRAM TO BE LAUNCHED. THAT GOVERNMENT LEADERSHIP MUST TRANSLATE ITSELF FROM THE STATE BENEFITS JUST DESCRIBED, INTO TANGIBLE ECONOMIC BENEFITS FOR THE AUTOMOBILE OWNER CURRENTLY DRIVING AN AUTOMOBILE NOT DESIGNED TO RUN ON METHANE, AND FOR SERVICE STATION OPERATORS NOT SET UP TO DISPENSE METHANE.

PRESUMABLY, IF THESE DECISIONS ARE POSSIBLE FOR THE INDIVIDUAL, THEN EQUIPMENT MANUFACTURERS, AND PERHAPS EVEN AUTOMOBILE MANUFACTURERS MIGHT MAKE APPROPRIATE COMMITMENTS TO PRODUCE THE NECESSARY HARDWARE.

THESE COMMITMENTS SHOULD INCORPORATE TECHNOLOGICAL ADVANCES.

WHAT ARE THESE TECHNOLOGICAL ADVANCES?

FOR THE ENGINE ITSELF, A SYSTEM NEEDS TO BE DEVELOPED WHICH WILL ADVANCE THE SPARK AND INCREASE THE COMPRESSION RATIO TO ACCOMMODATE THE HIGHER OCTANE RATING OF METHANE. A MUCH MORE SOPHISTICATED METERING SYSTEM FOR THE METHANE SHOULD REPLACE THE LOW PRESSURE FEED SYSTEM OF TODAY'S KITS.

13./

FINALLY, AND PROBABLY MOST IMPORTANTLY, ADVANCES NEED TO BE MADE IN STORAGE SYSTEMS. THIS IS BECAUSE THE COMPRESSED METHANE CYLINDERS ARE BULKY, COSTLY, AND PERMIT A RANGE OF ONLY ABOUT 1/2 THAT OF THE AVERAGE GASOLINE TANK ON TODAY'S VEHICLES. BETTER TANKS WITH A LARGER CAPACITY ARE BADLY NEEDED AS WELL AS SOME REDUCTION IN THE COST. IF WAYS COULD BE FOUND OF STORING METHANE THROUGH ABSORPTION ON A SURFACE THAT WOULD INCREASE THE CAPACITY AND REDUCE THE PRESSURE, THAT WOULD BE AN ENORMOUS ADVANCE. BETTER CRYOGENIC SYSTEMS MIGHT PERMIT LIQUID METHANE AS OPPOSED TO COMPRESSED METHANE TO BE USED AS THE STORAGE FUEL. THE DEVELOPMENT OF A LOW COST COMPRESSOR FOR HOME USE WOULD PERMIT INDIVIDUALS TO ATTACH THIS DEVICE TO THEIR FURNACE OR STOVE LINE AND TO REFUEL OVERNIGHT RIGHT AT HOME WITHOUT NEEDING TO VISIT A SERVICE STATION AS IS THE CASE FOR GASOLINE.

WHILE GREAT ADVANCES CAN BE MADE, IT SHOULD BE EMPHASIZED THAT ACCEPTABLE SYSTEMS ARE AVAILABLE TODAY MAKING ALL OF THESE SUGGESTIONS MERELY A THICK ICING ON THE CAKE. AND IT SHOULD ALSO BE EMPHASIZED THAT FOR THE FORESEEABLE FUTURE THE RECOMMENDATION IS THAT AUTOMOBILES BE EQUIPPED FOR DUAL FUEL AND THAT THE GASOLINE OPTION NOT BE DROPPED UNLESS AND UNTIL A HIGHLY DEVELOPED AND SOPHISTICATED REFUELLING SYSTEM IS UNIVERSALLY AVAILABLE.

14./

ONE STRATEGY BEING CONSIDERED BY OUR RESEARCH GROUP IN BRITISH COLUMBIA, HEADED BY PROFESSOR ENOCH DURBIN WHO IS ON SABBATICAL LEAVE FROM PRINCETON UNIVERSITY, IS TO RENEW AN OLDER CAR BY REMOVING THE AUTOMOBILE ENGINE AND REPLACING IT WITH A NEW OR REBUILT HIGHER COMPRESSION ENGINE HAVING A KIT ATTACHED TO IT. SUCH AN ENGINE COULD BE TUNED SO THAT IT WOULD RUN EFFICIENTLY ON BOTH METHANE AND GASOLINE. FROM A MECHANICAL POINT OF VIEW, IT IS FAR EASIER TO REMOVE A TOTAL ENGINE THAN IT IS TO ADD THE OPTIONAL EQUIPMENT. SINCE LABOUR WILL ACCOUNT FOR A SIZABLE PROPORTION OF THE TOTAL COST OF ADDING THE DUAL FUEL OPTION TO EXISTING CARS, THE ADDITIONAL BENEFITS FROM REPLACING THE TOTAL ENGINE SHOULD BE CONSIDERED.

A FEW FACTORY CARS ARE BEING PRODUCED TODAY WITH A DIFFERENT FUEL OPTION. THE FORD MOTOR COMPANY IS TO BE COMMENDED FOR ITS DECISION TO COMMENCE MARKETING AN AUTOMOBILE WHICH WILL RUN EXCLUSIVELY ON LIQUID PROPANE GAS. THE PROBLEM WITH LPG, UNFORTUNATELY, IS THAT THERE IS SIMPLY NOT ENOUGH OF IT TO PROVIDE A REASONABLE OVERALL SOLUTION FOR THE STATE. ABOUT FIVE PERCENT OF THE HYDROCARBONS FROM A GAS FIELD ARE PROPANE. PROPANE IS ALSO ONLY A MINOR PRODUCT OF OIL REFINERIES.

15./

IN BOTH CASES, PROPANE IS A BY-PRDOUCT, SO THE INCREASED DEMAND OF CONVERSIONS WILL NOT YIELD MUCH INCREASE OF SUPPLY. THEREFORE MASS CONVERSION TO LPG WILL CREATE A PROBLEM RATHER THAN PROVIDE A SOLUTION.

IF THE METHANE OPTION IS TO BE SERIOUSLY PURSUED, AMERICANS ARE BOUND TO ASK ABOUT THE LONG-TERM ADEQUACY OF SUPPLY. WITH PROVEN GAS RESERVES NOW ESTIMATED TO BE ENOUGH FOR ONLY ABOUT TEN YEARS, AT CURRENT PRODUCTION RATES, WHAT OF THE FUTURE ? I DO NOT FEEL QUALIFIED TO ENTER THE ARGUMENT NOW TAKING PLACE BETWEEN ENERGY OFFICIALS AND GAS COMPANY OFFICIALS AS TO THE TRUE AVAILABILITY OF METHANE SUPPLIES FROM CONVENTIONAL FIELDS, AND THE LIKELIHOOD THAT NEW GAS WILL BE DISCOVERED AS A RESULT OF THE NEW INCENTIVE PROGRAM OF THE UNITED STATES FEDERAL GOVERNMENT. BUT IT IS FAIR TO SAY THAT AT CURRENT PRICES, METHANE CAN BE MADE FROM COAL AT PRICES COMPARABLE TO THAT OF EQUIVALENT FUEL PURCHASED FROM OPEC NATIONS.

THE POTENTIAL SUPPLIES OF METHANE FROM COAL ALONE ARE SUFFICIENT TO LAST MANY DECADES IF NOT CENTURIES IN THE UNITED STATES. TO THIS MUST BE ADDED THE SOURCE FROM RENEWABLE BIOMASS. THUS, THERE NEED BE NO FEAR OF SUPPLY AND NO FEAR THAT COSTS WILL BE OUT OF PROPORTION TO THE ACCEPTED RATES OF TODAY.

16./

BUT WHAT WILL NEED TO BE DONE IF THE UNITED STATES IS TO PURSUE THIS POSSIBILITY AGGRESSIVELY IS TO USE THE TIME GRANTED US BY THE METHANE RESERVES TO DEVELOP, AS A FAIL SAFE SOURCE FOR THE FUTURE, THE CAPABILITY OF MAKING HIGH BTU GAS FROM COAL FIELDS OR EVEN BIOMASS AND PIPING THIS INTO THE EXISTING PIPELINE SYSTEM.

FOR A FEW NATIONS SUCH AS CANADA AND NEW ZEALAND, THIS DISCUSSION NEED NOT EVEN TAKE PLACE. SUPPLIES ARE ALREADY ENORMOUS, TO THE POINT WHERE NEW EXPLORATION IS NOT BEING VIGOROUSLY PURSUED BECAUSE THE PROVEN SUPPLIES CANNOT BE CONSUMED IN THE IMMEDIATE FUTURE.

WHAT IS PRESENTLY LACKING IS A GLOBAL STRATEGY FOR IMPLEMENTING THE CHANGEOVER. IT CANNOT BE DONE UNILATERALLY BY AUTOMOBILE COMPANIES BECAUSE THEY LACK THE CAPACITY TO MAKE FUEL AVAILABLE. IT CANNOT BE DONE UNILATERALLY BY OIL OR GAS COMPANIES, BECAUSE THEY DO NOT MAKE THE AUTOMOBILES OR THE EQUIPMENT. IT CANNOT BE DONE UNILATERALLY BY GOVERNMENTS BECAUSE THEY ARE NOT LARGE ENOUGH TO INFLUENCE THE INTERNATIONAL AUTOMOBILE, OIL AND EQUIPMENT COMPANIES.

17./

ALL OF THIS IMPLIES THAT NOTHING SHORT OF AN INTERNATIONAL, OR GLOBAL, STRATEGY TO DEVELOP THE METHANE ALTERNATIVE FUEL OPTION WILL BE ADEQUATE. POLITICIANS, AUTOMOBILE COMPANIES, EQUIPMENT MANUFACTURERS, OIL, GAS AND COAL COMPANIES AND BIOSCIENTISTS MUST WORK TOGETHER.

WHAT SHOULD THIS GLOBAL STRATEGY INCLUDE ? THE CARDINAL ELEMENT IS TO RECOGNIZE THAT INCENTIVES MUST BE PROVIDED TO THE MOTORIST. THE STATE MUST BE PREPARED TO TRANSFER THE BENEFIT TO THE INDIVIDUAL IN ORDER TO GAIN THE POLITICAL REWARDS OF GENUINE ENERGY INDEPENDENCE AND FISCAL STABILITY.

IN ADDITION, FURTHER INCENTIVES MUST BE PROVIDED TO STIMULATE A COMPREHENSIVE SYSTEM OF REFUELLING STATIONS TO BE DEVELOPED SO THAT OWNERS CAN USE THIS FUEL ANYWHERE.

NEXT, THE AUTOMOBILE MANUFACTURERS NEED TO BE GIVEN A STRONGER REASON THAN THEY NOW HAVE FOR INVESTING IN THE TECHNOLOGY OF IMPROVED METHANE BURNING ENGINES AND STORAGE SYSTEMS. THESE COULD BE IN THE FORM OF REDUCED TAXES ON NEWLY MANUFACTURED AUTOMOBILES AND SUBSIDIES FOR RETROFIT KITS ON EXISTING ENGINES.

18./

GLOBAL COOPERATION WILL BE REQUIRED TO PRODUCE COMPARABLE FINANCIAL INCENTIVES FROM NATION TO NATION, AND ESPECIALLY TECHNICAL DATA FOR APPROPRIATE SAFETY AND TECHNICAL STANDARDS. FINALLY, RESEARCH AND DEVELOPMENT MUST BEGIN TO EXPLOIT THE METHANE SOURCES BEYOND CONVENTIONAL GAS FIELDS.

I WOULD SUGGEST THAT TWO WORKING LEVELS ARE REQUIRED - ONE INVOLVING POLITICIANS TO SET APPROPRIATE POLICIES, AND ONE INVOLVING OFFICIALS AND MANUFACTURERS TO SET THE NECESSARY INFRASTRUCTURE IN PLACE. INITIALLY, THESE GROUPS SHOULD MEET TOGETHER IN ORDER TO SET STRATEGY. FOLLOWING THAT, WORK CAN PROCEED EFFECTIVELY TOWARDS IMPLEMENTATION.

IT SEEMS CLEAR TO ME FROM DISCUSSIONS I HAVE HAD WITH POLITICIANS AND OFFICIALS FROM SEVERAL COUNTRIES ON THIS GENERAL SUBJECT THAT SMALL JURISDICTIONS LIKE NEW ZEALAND OR EVEN CANADA WOULD FIND IT HARD TO BE EFFECTIVE ACTING IN ISOLATION.

BUT A SINGLE JURISDICTION, LIKE BRITISH COLUMBIA, CAN AT LEAST ATTEMPT TO ENCOURAGE OTHERS TO JOIN IN SETTING A GLOBAL STRATEGY.

19./

THAT IS WHY WE HOSTED A WORLD CONFERENCE ON METHANE AS A MOTOR VEHICLE FUEL IN VANCOUVER, BRITISH COLUMBIA ON SEPTEMBER 28 AND 29 OF THIS YEAR. THERE WERE CLOSE TO 500 POLITICIANS, ENERGY OFFICIALS AND TECHNICAL EXPERTS FROM A DOZEN COUNTRIES AROUND THE WORLD, WHO ASSESSED THE CURRENT STATE OF THE METHANE OPTION AND DISCUSSED THE BASIS FOR A GLOBAL STRATEGY.

THIS WAS A SMALL BUT SIGNIFICANT STEP TOWARDS PURSUING THE ONLY LOGICAL METHOD OF DECREASING DEPENDENCY UPON THE OPEC NATIONS. METHANE ALSO HAPPENS TO BE OUR BEST PROSPECT FOR A TRANSPORTATION FUEL WHEN TRADITIONAL OIL FIELDS TOTALLY RUN OUT.

METHANE AND HYDROGEN ARE THE SUCCESSORS TO GASOLINE, AND METHANE IS WITH US NOW. LET US COME TO OUR SENSES AND USE IT.

Mr. GLICKMAN. Thank you for the excellent testimony. I'm going to let the other members ask questions before I do because we may have a vote pretty soon and they may not be able to get back. Mr. Shamansky.

Mr. SHAMANSKY. With the discussion, Dr. McGeer, in our own country about the decontrol of natural gas, the figure you're giving of 90 cents to run 25 miles, would that figure go up? In other words, wouldn't it approach the cost of gasoline.

Dr. McGEER. The average cost of methane in the United States is approximately the same as it is in British Columbia. It varies greatly from place to place, but methane is quite cheap in many parts of the United States.

Mr. SHAMANSKY. What I'm trying to get at, is it cheap because of legislation or cheap because of market conditions?

Dr. McGEER. Well, of course, regulation has been a major impediment, not just to the free market but to the search for supply, and therefore that becomes a hard question to answer.

Mr. SHAMANSKY. I'm just responding to your stating what the cost is and I want to make sure that that cost was based on your estimate of what the cost would be if we had decontrol.

Dr. McGEER. It is based on what you are paying today.

Mr. SHAMANSKY. OK. So we couldn't necessarily assume that would be a fixed figure, because we anticipate it is going up greatly here.

Dr. McGEER. Yes, but then you should also anticipate that you'll discover a lot more——

Mr. Shamansky. Which leads me to my next question. On what basis do you make this prediction as to the availability of supply? Are those proven reserves or anticipated reserves or what?

Dr. McGeer. Well, the supply has been really thoroughly studied by the American Gas Association as to how much you have in proven reserves at the present time. The basis on which you suggest there'll be unlimited supply in the future runs from a variety of sources. The most important ones are the exploration for gas in deep wells, in addition to the pursuit of the conventional wells, which is starting to pick up again in the United States.

If those sources were to fail, which seems unlikely in most geologists' view, then one can make gas from coal, one can make gas from coal.

Mr. Shamansky. At what cost?

Dr. McGeer. At prices that would be less than the current prices you pay for OPEC oil. And there are unlimited supplies of coal in terms of a century or two in the United States. So that becomes the best backup reserve that you have.

Mr. Shamansky. We could also make gasoline out of that coal too, couldn't we?

Dr. McGeer. Not at this cheap price.

Mr. Shamansky. It would be cheaper to make methane from coal than gasoline?

Dr. McGeer. Yes.

Mr. Shamansky. You mentioned the American Gas Association. Do they have a program for converting their vehicles, their fleets as a starting point, across this country, for the use of methane to power vehicles?

Dr. McGeer. Some of them do.

Mr. Shamansky. Are they doing it now?

Dr. McGeer. Some of them.

Mr. Glickman. If the gentleman will yield, we will hear testimony from the AGA or a representative gas company that is doing that.

Mr. Shamansky. OK. Thank you, Dr. McGeer.

Mr. Glickman. Mr. Dunn.

Mr. Dunn. You made reference to several government policies that could be pursued, such as tax incentives or incentives for the stations, as well as that first group of automobile owners. Is this a policy that's going to be pursued by your country?

Dr. McGeer. Yes.

Mr. Dunn. Do you know how long before you'll be implementing it?

Dr. McGeer. We will have measures, I anticipate, in our next budget in British Columbia, which will be introduced probably in March. The Federal Government has given indications that they too might be prepared to pursue incentives once the stiff safety standards have been properly written in. In the meantime, they are supporting research and demonstration projects in Canada. So while I cannot speak for the Federal Government, I anticipate that they will be doing the same.

Mr. Dunn. So, would you say, a year from now we'll probably have a program like that, or not?

Dr. McGEER. Yes, they have already introduced an incentive program for propane automobiles in the Province of Ontario. That's because there is a short-term surplus of propane in Canada. I don't believe that program can endure, simply because there isn't enough propane to do it. It is a short-term measure because of the high subsidies that we are paying for OPEC oil, but the longer term prospect is definitely for methane, and I think that will be the program that will surpass and endure.

Mr. DUNN. When you mention the words, "safety considerations," I assume you're talking about the resulting pollutants from it?

Dr. McGEER. That's correct. Lower emission of noxious materials.

Mr. DUNN. And you don't feel that your research is far enough down that road that your Government can go ahead with the actual incentive policy? Is that what you're saying to me?

Dr. McGEER. What we have to have available before you can encourage large-scale conversions, you've got to have a string of gas stations available, you've got to have competent people who can make the conversions, you have to have——

Mr. DUNN.. Yes, but are you ready to do that, or are you still working on the emission standards?

Dr. McGEER. No, no. The emission standards for the vehicles are not a problem at all.

Mr. GLICKMAN. I think, if the gentleman will yield, it's been documented that methane vehicles can be operated, as a general proposition, at significantly lower emission standards across the board than gasoline.

Mr. DUNN. You mean, it's easier to meet the standards?

Mr. GLICKMAN. They meet them now. They meet the new ones, and the ones in the future. The level of NO_x, the level of hydrocarbons, and the level of carbon monoxide, I believe, are all lower.

Dr. McGEER. Much lower, much lower. The unburnt methane, of course being lighter than air, just moves up through the atmosphere. There's a considerable amount of unhappiness, as you gentlemen probably know much better than I do, about the way in which the exhaust pollution problem has been approached in this country, because the catalytic converters have done two unfortunate things. The first is, they have persuaded automobile manufacturers to put out much inferior engines. The compression ratio of the engine is dropping and as a result of that the efficiency of the engine declines dramatically.

The attractive thing about natural gas is that the compression ratio of the engine can go up and therefore the efficiency can be improved enormously. However, it's like giving an automobile that's been designed for slop, roast beef, if you give methane, which has a 130-octane number, to a current Detroit automobile that's made to meet emission standards and has a catalytic converter in the exhaust and has a compression ratio of 7.5 to 1, and runs on gasoline with an octane rating under 90.

The other unfortunate consequence is that the refineries now are obliged to make nonleaded gasoline so that refinery efficiency has gone down by about 20 percent, and all of this increases the dependence on OPEC for the same number of miles driven. You've given up efficiency of the automobile operation and you've given up efficiency in the refinery.

Mr. DUNN. I guess I don't understand that. If the pollutants aren't a problem and the research is done, what is preventing your Government from going right to the stations, implementing the tax incentives which you talked about, and subsidizing those first few hundred automobile owners?

Dr. McGEER. Nothing. That's going to start right now. It's just that the laying of the infrastructure has taken place between the last budget that our Government introduced and the next one.

Mr. DUNN. Well, I mean, a year from now, could we have a model program that this country might benefit from?

Dr. McGEER. That's my hope. Yes. You've got your model program now, in New Zealand. You don't really need to wait.

Mr. GLICKMAN. How many cars operate on methane now in New Zealand? Do you know?

Dr. McGEER. They're getting up toward between 50,000 and 100,000.

Mr. SHAMANSKY. I still, because of the number of vehicles, am wondering. It's your belief that we have enough supply available——

Dr. McGEER. Yes.

Mr. SHAMANSKY [continuing]. To continue to heat our houses? Isn't that like another hundred million houses to heat?

Dr. McGEER. Yes.

Mr. SHAMANSKY. In a short time?

Dr. McGEER. Yes.

Mr. SHAMANSKY. We have that availability?

Dr. McGEER. Yes.

Mr. SHAMANSKY. In terms of supply. Just a question of distribution?

Dr. McGEER. Yes.

Mr. SHAMANSKY. That's a big claim.

Dr. McGEER. Yes.

Mr. SHAMANSKY. I want to make sure we don't get any noes in there, that's all. Thank you, Doctor.

Dr. McGEER. But why one can be so dogmatic is because if for some unknown reason people are unable to find supply in the United States to carry you beyond the 10 years' proven supply that you have at the present time, you can still within that period of time establish coal conversion plants that will fill your pipelines and therefore give you that security. And you know the coal is there, so that there need be no fear that if one embarks upon this program we're going to be left with 100 million automobiles that can't run or with homes that are without heating.

Mr. GLICKMAN. Well, as a practical matter——

Dr. McGEER. The technology to convert the coal is already known. There's a million miles of pipeline already built and once that material comes out of the coal plant, unlike what happens with coal liquefaction, you don't then have to take it to a refinery and then take it by truck to the gasoline station. You've already got the pipeline system built, so it comes directly out of your coal plant, through the pipeline system, to the service station. No more refineries.

Mr. **Shamansky.** I realize we're going to get testimony from the Department of Energy, but is this news to the United States? I mean, it's news to me.

Dr. **McGeer.** If you talk to people whom I believe are knowledgeable, yes, you'll get all of these answers. But the problem in many countries has been that the wrong voices have been listened to. There isn't a country in the world that hasn't had confusion with its energy policy, and even countries that have been bolder and more progressive than Canada or the United States have stumbled, not because the people who gave advice didn't clearly see what should be done and give an excellent program of action, but because others along the way began to insert their policies and caused it all to stumble.

May I give you one example? In Brazil, they are pursuing an option that they have to pursue at the present time because they lack oil, natural gas, and coal. They have got sugar cane so they are going to alcohol. Seventy percent of all of the automobiles sold in Brazil last December were ethanol-fueled vehicles. Confusion. Arguments between the Ministry of Energy and the Ministry of Industry in Brazil. A temporary shortage of alcohol supply. Mistakes made in utilizing alcohol in gasoline cars and gasoline in alcohol cars. Things that weren't adequately anticipated by making the fuel colored. Result? Last month, in Brazil, 1.8 percent of the automobiles sold were alcohol vehicles.

So you can go from 70 to 1.8 percent with just a few Government mistakes.

Similarly, in New Zealand, they set targets of 15,000 vehicles the first year, I think, and 30,000 vehicles a year after that. The people were trained to make the conversions, the kits were imported and were sitting on the shelf, the Government announced an incentive program, but the Ministry of Finance in New Zealand decided that people who were driving methane vehicles would have to pay their road tax like everybody else. So they put in a system, since you can't figure out quite how to do that at the pump, where people who are driving methane vehicles had to go into a Government office every month or 2 months, have their odometer read, and pay a tax on the spot. More than that, even though they were saving enormous amounts of money on OPEC oil being imported to New Zealand, they decided they weren't going to let any of those kits come in duty free. So everybody had to pay the duty on the kits. And the people say, ha, if the Government is going to nitpick us on taxes and try and get all their duties and everything, they can't be very serious, so we won't convert. Result? Conversions dropped almost to nothing. So the people who had imported the kits had them sitting on the shelf, the mechanics who'd been trained were picking their noses, and nothing was happening in New Zealand.

So the Government had to come to its senses and reinstitute a straightforward program. And as you gentlemen know as well as I do, governments don't speak with one voice. There is always the Ministry of Finance in it, the Ministry of Energy, and the Ministry of Industry, and if people get a little bit confused, they're going to change their habits. The whole essence, it seems to me, of this symbiotic relationship that now exists in every developed country, between the consumer who makes the decision and the state, is that the state can't benefit until the consumer makes the right decision. And that consumer is going to be guided very much by what the automobile manufacturer does, what the fuel manufacturer does, and what the government does.

But really, the government is the only one that can provide the leadership. They're the only one that can restore this balance, they're the only one that can give the confidence. And as long as OPEC can keep us off balance, then, of course, it's to the benefit of OPEC and to our disadvantage.

Mr. GLICKMAN. Thank you for your excellent testimony. I'd like to keep you here for a lot longer but we have other witnesses and we have a lunch to go to, a little later on. We appreciate the excellent testimony. I think it's some of the best testimony that we've heard in a long time on the issue of fuels, automobiles, and related issues. And we appreciate your being here. Thank you, Dr. McGeer.

Our next witness is from the Department of Energy, Dr. Maxine Savitz, Deputy Assistant Secretary for Conservation, accompanied by Henry Stadler, who is the Director of the Vehicle and Engine Research and Development Program at the Department of Energy.

STATEMENTS OF DR. MAXINE SAVITZ, DEPUTY ASSISTANT SECRETARY FOR CONSERVATION, U.S. DEPARTMENT OF ENERGY, WASHINGTON, D.C.; AND DR. HENRY STADLER, DIRECTOR, VEHICLE AND ENGINE RESEARCH AND DEVELOPMENT, U.S. DEPARTMENT OF ENERGY, WASHINGTON, D.C.

Mr. GLICKMAN. Maxine and Henry, it's a pleasure to have you here. We appreciate your testimony, and as I have said before, your entire statement will appear on the record so you may summarize or proceed as you wish.

Dr. SAVITZ. Mr. Chairman and Congressman Shamansky, it's a pleasure for us to be here today, and I will just summarize briefly what we have in our testimony.

Upon passage of the Methane Transportation Research, Development and Demonstration Act of 1980, the Office of Vehicle and Engine R&D, of which Dr. Stadler is the head, was given the responsibility for implementing the act. Prior to passage of the act, about 15 months ago in October, we sponsored a 1-day workshop within industry and Government participants to discuss the key areas of interest and to identify areas for an assessment of methane fuel for automotive fleet vehicles.

The objectives were to review the state of the art of methane vehicle technology, compile existing data, and identify areas where R. & D. would be desirable. We undertook the assessment in the area of safety, supply economics, energy efficiency for transportation systems, emissions and fuel economy, and end-use economics.

That draft report has now been prepared and is being circulated for review and comments by the industry and government participation, and we will be having that final report available at the beginning of the year.

So, as you know, during your subcommittee hearings last March we discussed the Department of Energy's fiscal year 1982 budget request for the area of activities related to the methane bill. In the current DOE budget request for 1982 reflecting the administration's policies of allowing market forces to determine needs and having the private sector undertake near-term R. & D., does not include funds to implement the demonstration program defined by the act.

However, we've reviewed and discussed the possibility of doing some of the longer term research and development activities on methane-fueled vehicles as part of our existing alternative fuels utilization program. And of the $5.4 million requested for that area, we are planning to spend $510,000 this current fiscal year for methane research and development. And the items we will do our research on have been identified as part of this assessment.

We're also very pleased with some of the things that the industry itself is doing to develop vehicles. An example is a program underway at Ford Motor Co. where they are concentrating on improved fuel storage systems such as light-weight composite tanks and optimization of the basic engine by designing specifically for CHG or LNG.

In the alternative fuels utilization program we look mainly at the end use of alternative fuels transportation and do not look at the supply end of the system and distribution. They're done with other parts of DOE. In addition, the safety of fuel and fuel systems is something that the Department of Transportation has responsibility for, but we anticipate working with them and have done that in other programs such as the electric vehicle program.

In the plans for fiscal year 1982 DOE will do some limited safety activity, look at some fire and impact testing of CNG and LNG, but no vehicle crash testing at this time is planned.

The type of R. & D. program that we think will be most beneficial would be developing an engine performance data base to be used by industry in the design and development of advanced systems. For example, a single-cylinder laboratory engine could be used to investigate the effects of various parameters such as compression ratio, air-fuel ratio, spark timing, valve timing, and charge pressure, and the effects of these on efficiency, power, and emissions. This basic data could then be helpful for industry to then go ahead and develop the improved gasoline and diesel engines, rather than our developing engines. We would just develop data.

Another area and one we weren't able to cover in our assessment is institutional barriers. Most often, I think, as the previous witness also said, they are not technological problems but institutional barriers which relate to legal restrictions and others. So we will be assessing items such as tunnel and road restrictions, storage regulations, emission regulations, fuel standards, dual-fuel requirements, and guaranteed supply, and see their impact on methane vehicles.

Those are the type of activities that we would see doing this current fiscal year.

I want to mention two other activities that we have done related to the act. One is that last week we published the regulations required to specify procedures that any new R&D funded would supplement rather than supplant, duplicate, or displace the private sector activities. And there will be a public hearing on this rule December 4. And the other item is the development of data assessing the current state of the art and a draft report has been prepared to satisfy this requirement. That information came from the assessment that we started, and it's expected to be available by the statutory deadline.

In conclusion I would say that we're proceeding with doing the research and development that we mentioned earlier in the year, and the assessment is serving as a primary basis for developing the plan. During the course of the year we've sought and obtained very good advice from the private sector and also from the other Government agencies.

[The prepared statement of Dr. Savitz follows:]

STATEMENT OF

DR. MAXINE SAVITZ

DEPUTY ASSISTANT SECRETARY FOR CONSERVATION

CONSERVATION AND RENEWABLE ENERGY

BEFORE THE

SUBCOMMITTEE ON TRANSPORTATION, AVIATION, AND MATERIALS

COMMITTEE ON SCIENCE AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

NOVEMBER 19, 1981

Mr. Chairman and Members of the Subcommittee:

Thank you for the invitation to appear before the subcommittee. It is my purpose in this testimony to provide you with a concise summary of the status of DOE activities related to the Methane Transportation Research, Development, and Demonstration Act of 1980 (P.L. 96-512). The Office of Vehicle and Engine R&D (formerly the Office of Transportation Programs) has the responsibility for work related to implementation of the Act. In August 1980, prior to passage of of P.L. 96-512, we sponsored a one-day workshop for industry and Government participants to discuss the key areas of interest and to identify pertinent topics for a DOE assessment of methane fuel for automotive fleet vehicles. We then conducted this assessment in the areas that we judged to be most crucial. The objectives were to review the state-of-the-art of methane vehicle technology, compile existing data on methane-fueled vehicles as currently used, and identify areas where R&D work may be desirable. There were five assessment tasks undertaken in this study: (1) safety, (2) supply/economics, (3) energy efficiency for transportation systems, (4) emissions/fuel economy, and (5) end/use economics. A draft of the study report has been prepared and distributed for review and comment to numerous people in industry who have expertise on the subject. Review comments have been received and are being incorporated into the final report.

During hearings of this subcommittee on March 11, 1981, the subject of DOE expenditures for FY82 in the area of methane fuel for automotive fleet and farm vehicles was discussed at some length. As you know, Sec. 10 of P.L. 96-512 authorized appropriation of $3 million for FY82 of which at least $1.5 million was to be used for loans to support vehicle demonstration projects. The current DOE budget request for FY82, reflecting the Administration's policies of allowing market forces to determine needs and having the private sector undertake near-term

R&D, does not specifically include funds to implement the program defined by P.L. 96-512. However, DOE has reviewed the possibility of including long-term R&D activities on methane-fueled vehicles as part of its existing Alternative Fuels Utilization Program (AFUP) within the Office of Vehicle and Engine R&D. In determining the technology agenda, we concentrated our methane activities on research and critical technology barriers which inhibit methane's use in transportation rather than on demonstrations. The demonstration program outlined in P.L. 96-512 has not been pursued because much of the technology associated with methane-fueled vehicles is already being demonstrated in commercial fleet operations and with advanced prototype systems. Data gathering through demonstration projects would be duplicative of industry programs and inconsistent with the Administration's policies.

Of the $5.4 million AFUP budget request for FY82, we now estimate that $510,000 will be allocated for methane R&D. The program plan is still being formulated. We are essentially striving to meet the intent of the R&D program outlined in P.L. 96-512 consistent with the Administration's focus on longer-term, high-risk R&D that will not be pursued by the private sector.

The assessment that was conducted identified a number of technical areas where additional work would be advantageous. Several areas are already under investigation by private industry and will not be duplicated by DOE. There is substantial industry involvement in methane-powered vehicles, including not only the commercial sale of vehicle conversion and refueling hardware but also development of advanced prototype systems. A notable example of the latter is the R&D program underway at Ford where efforts are concentrating on improved fuel storage systems, such as lightweight composite tanks, and optimization of the basic engine by designing specifically for CNG or LNG. With consideration of the Act's provision that the R&D program supplement rather than supplant, duplicate, displace, or lessen the R&D efforts of the private sector, our program will be designed to supplement industry in its own R&D endeavors. In this sense, the Administration's emphasis on long-term research is in agreement with the intent of P.L. 96-512, since industry is actively pursuing near-term R&D on methane vehicles.

An objective of the AFUP is to investigate and advance the technology base associated with the end use of alternative transportation fuels. Topics related to supply and distribution aspects are not normally addressed as part of AFUP projects except through coordination with other DOE offices. Although the safety of fuels and fuel systems is an end-use topic, the Department of Transportation normally has responsibility for programs dealing with vehicle safety. Because of this, we anticipate that safety-related activities using AFUP funds will be very limited in scope. No safety projects, e.g., vehicle crash testing, that would include formal DOT involvement are planned.

With these considerations in mind, a Government R&D program would seem to be most beneficial by developing an engine performance data base to be used by industry in the design and development of advanced systems. For instance, a single-cylinder laboratory engine could be used to investigate the effects of various parameters (e.g., compression ratio, air-fuel ratio, spark timing, valve timing, charge pressure) on efficiency, power, and emissions. Such basic data have been extremely helpful in the development of improved gasoline and diesel engines, and similar efforts are underway to investigate promising alternative fuels in the same manner.

Another project which is planned as a part of our FY82 AFUP was identified in Sec. 6 of P.L. 96-512. This is the assessment of institutional barriers to the expanded use of methane-fueled vehicles. This effort was confirmed as a desired task at our one-day workshop but was beyond the scope of the initial assessment. The institutional barrier question pertains to both legal restrictions and the practicalities of methane vehicle fleet operations. Specific items to be addressed include tunnel and road restrictions, storage regulations, emissions regulations, fuel economy standards, dual-fuel requirements, and guaranteed supply.

I have only briefly attempted to convey the types of DOE activities which can be reasonably undertaken and yet could maximize benefits to the private sector. I must reiterate, however, that final decisions on specific projects have not yet been made.

Two other DOE activities related to P.L. 96-512 should be mentioned here. One of these items is the issuance under Sec. 4(d)(2) of administrative regulations specifying procedures to assure that new R&D funded under the Act would supplement, rather than supplant, duplicate, displace or lessen, private industry R&D efforts. These regulations have been drafted, and the notice of proposed rule making was published in the Federal Register on November 10, 1981. A public hearing on the regulations is scheduled for December 4, 1981.

The other item is the development of data assessing the current state-of-the-art of methane-fueled vehicles to serve as baseline data for evaluating technology improvements. This requirement is defined under Sec. 7(a) as part of the demonstration program. A draft report has been prepared to satisfy this requirement, utilizing the information gathered during the assessment effort, and is expected to be available by the statutory deadline of January 1, 1982.

In conclusion, let me say that DOE is proceeding with its program planning for FY82 projects on methane-fueled vehicle R&D that are consistent with the Administration's energy R&D policy. The assessment we have conducted is serving as a primary basis for development of the program plan. During the course of the study, we have continuously sought the advice and critique of the private sector. We will continue to do so since such consultation is in the best interest of Government, industry, and the Nation.

Mr. GLICKMAN. Thank you, Maxine. I noticed in the Federal Register on Tuesday, November 10, 1981, which I believe is noted in your testimony, about the fact that regulations on R. & D. would supplement, not duplicate, is the following statement:

> Were it not for the legal requirement to promulgate these regulations, DOE would not do so because the Administration, as part of its policy of budgetary restraint, has proposed to Congress to prohibit the Department of Energy from expending any funds to carry out this Act.

That's pretty clear language. I assume what that's basically saying is that if it were not for Congress pushing the Department you probably wouldn't be continuing the activities that you talked about today.

Dr. SAVITZ. We still may have done some of the R. & D. activities under that alternative fuel utilization category, which we could have done under our general R. & D. authority, and didn't need a special law for. That program has consistently looked at new fuels, to try to get data on performance of new fuels, concentrating first on alcohol base fuels, and looking now, more at some of the synthetic fuels. So, it would be consistent with what that subprogram has been doing anyway, but I think——

Mr. GLICKMAN. What I'm saying is, the earmarking or the targeting on methane would not have occurred?

Dr. SAVITZ. Would not have occurred. Exactly.

Mr. GLICKMAN. Based upon your information to date, is it accurate that the use of natural gas in automobiles does produce less emissions?

Dr. SAVITZ. Yes, and also in our discussions with EPA they are intent on proposing some regulations that will also state that they meet emissions requirements.

Mr. GLICKMAN. Have you or anybody at DOE established miles per gallon comparisons between gasoline and either LNG or CNG vehicles?

Dr. SAVITZ. They come out roughly the same, but we do it on the BTU basis. We have not published or formalized any kind of equivalent miles-per-gallon gasoline with equivalent miles-per-gallon methane, as we have in the electric vehicle.

Mr. GLICKMAN. Henry.

Mr. STADLER. I think that part of the problem here, Mr. Glickman, is that there's a difference between retrofitted cars and new cars. As Dr. McGeer explained, if you are using a car designed for gasoline and you have used methane in it, you may very well not do nearly as well as if you initially designed the car for methane. So there's a range of experience. But within that, in the retrofit cars, I think we find that the heating value is about the same.

Mr. GLICKMAN. So it would probably be better in a car specifically designed for methane.

Dr. STADLER. I think in a specifically designed car you could utilize the very high octane value, you could use the possibility of sophisticated emission reduction because of the vaporized fuel, and there are various things which are potential advantages. But it's very hard in a small study to determine what those give you. We're hoping that the Ford Motor Co., among others, will give us information about that.

Mr. GLICKMAN. Now, are those studies on the basis of compressed natural gas or liquefied natural gas, or both?

Dr. STADLER. With respect to these engine things, by the time the fuel gets to the engine it's pretty much the same. It's a little bit cooler, perhaps, coming from the liquefied, but they're very much similar.

Mr. GLICKMAN. When do you expect that the Department of Energy will make a final decision on the specific project activities for implementation of this act, the methane law?

Dr. SAVITZ. We've decided on the four areas, already, that we want, which I've mentioned in the testimony, like the institutional barriers, and getting some data with advanced engines. What we now have to do is write the specific statements of work and then go competitive with those that will be competitive. And the statements of work should be finished in January and be able to release those in the Commerce Business Daily and make the awards by June or July.

If we go noncompetitive, which we may do on one of the safety studies, that could be awarded earlier, in the winter.

Mr. GLICKMAN. You know, one of the things that strikes me is that this law provides a limited scope of research activities. Dr. McGeer, however, talked about some more fundamental issues. How does one get the consumer to feel that there is a market for the product? Have you worked with any of the other departments of this Government, the Department of Treasury or the Department of Defense? I am aware, for example, that the Department of Defense has just recently begun to have an active interest in methane, particularly in LNG as an airplane fuel, as well as a motor fuel. I think the work that you're doing is very necessary, and I'm glad that we have been able to at least earmark a little bit of money for continuing research. But fundamentally, the issues regarding methane are not all that terribly new. It works, it's not a terribly exotic technology, but you can make cars to run on it. We've got some things to work out, and the question is, how do we get over that institutional barrier and begin developing one alternative fuel in these United States that folks can use in fairly great numbers?

Dr. SAVITZ. Well, we've been in, and also participated in the assessment, people from GSA and the Post Office and DOD, so that they're aware of the state of the art and who supplies it. The Air Force has contacted us on the possibility of doing a joint program whereby they would outfit a certain number of vehicles with, I don't remember whether it's CNG or LNG, but do that and get basic data.

Mr. GLICKMAN. You mean aircraft or automotive?

Dr. SAVITZ. Automotive.

Mr. GLICKMAN. I have heard of some aircraft being considered now as well. One of the companies in my district, Beech Aircraft, has an LNG aircraft.

Dr. SAVITZ. This is automotive. And we just, you know, are not continuing to do those kinds of demonstrations, or data development. We would be happy to have them do it on their own, and provide them with whatever information we have. And that will be a decision they'll have to make.

In other programs like the electric vehicle, where we've had other departments actively participating, it's always been on a cost-sharing basis. The departments themselves have not done it.

I think, though, there's a lot of opportunity and our market study, and the American Gas Association market studies show that fleets, the Government being one source of fleets, are a good opportunity. Utilities are another source of opportunities for using of methane. The gas utilities and also things like the telephone utilities. We've had some conversations with GTE and they are looking into the possibility of methane for their fleet use. So I think that to try to encourage the private sector, in addition to the public sector, to do it can help build that infrastructure that's needed, that Dr. McGeer talked about previously.

Mr. GLICKMAN. Mr. Stadler.

Dr. STADLER. I think the most successful country in the world in getting methane into use is Italy, and there it seems to be not primarily stimulated by the National Government, except insofar as the high price of gasoline compared to the price of methane encourages it. And they have about a quarter of a million methane-fueled vehicles and the numbers of them seem to vary just according to the difference in the price between those two fuels.

Mr. GLICKMAN: You mean the differential in the price alone is enough to do it?

Dr. STADLER. Yes. As you know, in Italy, the price of gasoline is a good deal higher than it is here.

Mr. GLICKMAN. So the differential on a percentage basis would be much greater than it is here?

Dr. STADLER. Oh, yes. Yes.

Mr. GLICKMAN. Mr. Shamansky raised the issue about the supply of gas. Do your figures generally correspond to what Dr. McGeer was talking about in terms of the supply of gas?

Dr. SAVITZ. There have been more finds of gas in the last couple of years than before, and numbers vary from how much we would have to import in 1990, a relatively small amount, a trillion cubic feet, and the gas industry is finding a lot of finds and is quite bullish that there will be more of a supply available than there may be conventional uses for it. So the question is going to be, at what price?

Mr. GLICKMAN. The intriguing thing about gas is that there's the highway for gas, the pipelines are there. That differentiates it from other sources of energy except electricity. The distribution system is on line, ready to go, for all practical purposes.

Dr. SAVITZ. For most purposes.

Mr. GLICKMAN. There probably isn't an immediate distribution scheme to get it to all consumers. I was in Canada and spoke at a conference on this subject and I'm aware now that some companies are beginning to consider installation of home compressors that one could refuel an automobile right from the pipeline to the garage without having to go to a compressor station. But it intrigues me that we have a distribution scheme or plan in place.

Dr. SAVITZ. When I think that the gas industry is very concerned that there's going to be a lot of available gas and are looking for new markets, and I think this is, again, most people are converting from oil to gas for their residential heating, and that will continue as long as there's a price differential. As soon as prices become equivalent, then it's questionable. But I think the fact is, they're looking for a market and there's a lot they can do to promote gas, as they have done successfully in the markets that they're currently in.

Mr. GLICKMAN. Mr. Stadler?

Dr. STADLER. I just wanted to add that although we are not able to finance demonstrations, I did suggest a few months ago to the people at Beech Aircraft that perhaps using liquefied natural gas in trucks, in heavy trucks, would be a pretty interesting thing. You could do that on one of our big truck highways that would limit the number of places where you'd have to have the facilities for fueling, and the heavy trucks could accommodate the liquefied natural gas better than smaller vehicles. I think it's conceivable that that kind of a direction might be a useful way to go.

Mr. GLICKMAN. I might close my own comments by saying that I acknowledge that the demonstration part of the program is not going to be funded. I am glad to know that for whatever reason you are implementing the research part of that act. The main reason that I pushed this law last year was really to assure that the public was aware of this alternative fuel because it has more immediate capabilities of being implemented than any other alternative fuel that we have. So I would hope that in your efforts and understanding this administration's philosophy to encourage the private sector to do these things, that you will do those kinds of things which will make the market possibilities more feasible for them and answer those kinds of questions that for a variety of reasons they can't answer.

I still have this inkling underneath everything else that this is the fuel we need to look at. Mr. Shamansky asked Dr. McGeer the question, well, we have 10 million vehicles, and what happens if we run out of natural gas? I suppose the more realistic question is, we have all those vehicles now and we're about to run out of oil. Or we're at least on the downside of that picture.

Dr. SAVITZ. As he said, the gas can be made from coal too.

Mr. GLICKMAN. Also from biomass and from sludge and everything else. Mr. Dunn.

Mr. DUNN. I wasn't sure what relationship you had with Beech, but would you explain that. You are cooperating with them in their research?

Dr. STADLER. No, I just made a casual suggestion to them that I thought that perhaps they would like to pursue in the private sector, encouraging some people in the class A truck area to try putting in one of their—you know, they have these thermos bottles that are very large, and that that would be an appropriate place for that, and allow you with a relatively small amount of fairly large storage facilities to actually use it to replace some of the very significant gasoline consumption, or diesel oil consumption.

Mr. DUNN. But they aren't doing research for aircraft?

Dr. STADLER. For aircraft?

Mr. GLICKMAN. Well, yes, as a matter of fact, I'm going to fly a methane-powered plane on Monday. I would hope that their research is more than just on paper. Thank you very much for your testimony.

Our next witness is Bill LaLonde, President and Chief Executive Officer of the Gas Service Co. in Kansas City, one of the companies that has begun implementing the use of methane.

STATEMENTS OF WILLIAM LaLONDE III, PRESIDENT AND CHIEF EXECUTIVE OFFICER, GAS SERVICE CO., KANSAS CITY, MO; AND MR. RANDALL COLE, MANAGER, ENERGY RESOURCE AND DEVELOPMENT, AMERICAN GAS ASSOCIATION, ARLINGTON, VA.

Mr. GLICKMAN. As I said, you may feel free to summarize. Your entire statement will appear in the record if you desire, or read from it completely, whatever is your pleasure.

Mr. LALONDE. Thank you.

Mr. GLICKMAN. We're moving along rather rapidly so you have some extra time.

Mr. LALONDE. Thank you, Mr. Chairman. I have a brief statement which is a summary of a longer statement which we plan to put in the record.

I'm William LaLonde, President and Chief Executive Officer of the Gas Service Co. and I'm representing the American Gas Association. AGA is a national trade association with nearly 300 members of the national gas distribution and transmission industry, serving over 160 million consumers in all 50 States.

With me is Randall Cole, our manager of energy resource development at the American Gas Association.

We are pleased to provide you with our industry's views on the implementation of the Methane Transportation Research Development and Demonstration Act of 1980. And hopefully, we will use the words methane, natural gas, and gas interchangeably, and I will be very careful not to use gas to mean gasoline.

Incidentally, my company currently operates over 800 vehicles on compressed natural gas, including my own. And I even have installed a compressor at my home for convenient after-work fueling.

Natural gas currently provides 27 percent of the energy consumed in the United States and more gas is produced domestically than any other fuel. Gas provides about 46 percent of the energy used in the U.S. residential and commercial establishments and 36 percent of the energy consumed by U.S. industry and agriculture. Unfortunately, gas supplies only about 3 percent of the energy consumed by the transportation sector. This is 55 times the amount supplied by electricity but it is far below the amount of energy supplied to this sector by petroleum.

The AGA believes that natural gas has a greater potential as a motor fuel to relieve our dependence on petroleum than any other alternative. The use of natural gas as a transportation fuel offers national advantages when compared with other transportation fuels from conservation, economic, environmental, safety, and supply standpoints. These advantages were the primary reason for AGA's active support of the act from its introduction to the present. We are therefore very appreciative of your leadership, Chairman Glickman, in introducing legislation that became the act, and your strong support for insuring funding and implementation of this act.

When the American public is willing to spend $10,000 to $12,000 for a new car with better gasoline mileage, will you believe that $1,000 to $1,500 necessary to provide dual fuel capability is entirely justified? Using natural gas will cut a driver's costs by at least 25 percent, even taking the annualized cost of the compressor station into account. Cutting 25 percent is the equivalent to increasing mileage by 33 percent.

The AGA is active in promoting and marketing natural gas as a vehicular fuel. As part of this activity AGA is sponsoring a major conference on methane-powered vehicles to be held in Washington May 5 through 7 in 1982. The theme of that conference is, "Today's Alternative for Tomorrow." We hope to attract at least 400 attendees. This conference would, therefore, be about the size of the very successful Vancouver, Canada, conference where Chairman Glickman made a keynote address.

In addition to sponsoring this conference, AGA has prepared a marketing plan which is attached to our written statement. This plan points to several reasons why DOE should actively implement the act. I will briefly summarize these reasons.

One. Every million vehicles converted could save approximately 70,000 barrels of imported oil per day, thus complete saturation of the 8 million vehicle fleet market in current use would displace about 560,000 barrels of oil each day, and this represents 10 percent of our national imports.

Two. More and more gas will become available over the next 20 years as new sources such as Alaskan gas, coal gas, deep and tight sands gas play greater roles in our national supply of energy. These new supply sources combined with residential and business conservation need to be marketed.

Three. Natural gas use in vehicles would be year-round, thus helping to balance our demand between summer and winter use. Currently most pipelines are built to run near or at capacity during the coldest periods. During the summer, however, much of that capacity is unused. Unused capacity means higher average prices to the consumer, and by using natural gas in vehicles more capacity will be utilized, resulting in benefits to all consumers.

Four. Methane is clean-burning and nonreactive. In other words, it does not contribute to the formation of smog.

Five. Compressed natural gas and liquefied natural gas have been used successfully in the United States for over a decade. In Europe natural gas has been used as a motor vehicle fuel for over 40 years. Natural gas as a vehicle fuel is a concept which has proven itself to be cost-effective.

With all the good things AGA's marketing plan says about natural gas as a motor fuel, you might wonder why almost everyone is still driving with gasoline. The fact of the matter is that many companies, including my own, are aggressively marketing conversion equipment. We regularly meet with city leaders, private companies, with fleet owners that are candidates for conversion. These city leaders or businessmen leave the meeting understanding the cost benefits to them but are frequently concerned that the Federal Government has never put its stamp of approval on the technology.

This act, passed with those people in mind, should help to rectify the situation. DOE was supposed to implement the act and it was expected that DOE would signal approval. Thus far AGA has been generally disappointed with DOE implementation. DOE recently released a draft study entitled "Assessment of Natural Gas Application to Automotive Vehicles," which was prepared under contract by the Aerospace Corp. of El Segundo, Calif.

While we were encouraged by the effort to pull together a large amount of data and information on natural gas an an automotive fuel, we expressed to DOE several general and specific shortcomings of the report. We believe that the draft report provides inadequate insight as to the inherent advantages of methane-powered vehicles and often portrays natural gas in an unnecessarily negative manner.

In particular, this study fails to address institutional barriers and therefore offers no recommendations concerning them. We in the industry see many institutional barriers that need to be overcome. One such barrier is a potential problem under the Natural Gas Act for a local distribution company which sells natural gas to a service station for resale to the public. Such a transaction could make the distribution company subject to FERC jurisdiction under current law.

Another problem is the current restrictions limiting use of gaseous-fueled vehicles in tunnels and bridges. Such restrictions are based on preconceived dangers of natural gas as a vehicle fuel. It is obvious that the wider dissemination of studies showing how safe natural gas use is could do much to eliminate this barrier. Further DOE safety research would be even more authoritative.

This DOE study also fails to address recent developments in the research on storage containers which may promise significant reduction in weight and increased range. Obviously, we feel this report shows a basic lack of understanding of natural gas as a motor fuel. We hope that additional input from the gas industry, equipment manufacturers, and from this subcommittee will result in significant changes in the final report.

AGA has also been disappointed with DOE in the administration budget request for implementing this act. We are, though, gratified by this subcommittee's work to insure that a half a million dollars is made available in fiscal year 1982 under the DOE alternative fuels utilization program. We hope the administration in its effort to continue reducing oil imports will allow funds to be used as directed in fiscal year 1982. We also hope that funding is provided in fiscal years 1983–1984, and we pledge our support to that end.

Such funding would allow needed research activity to be performed in the areas of safety and safety standards, storage containers, emissions, advanced concepts in motor parts design to improve efficiency. Similar to Representative Glickman, we were dismayed by DOE's attitude in the area of the methane-powered vehicles as earlier expressed.

This is the kind of attitude DOE had prior to the passage of the act, which necessitated congressional action directing DOE to take a better look at natural gas use in motor vehicles. This is not the attitude of an agency following the intent of Congress. May I quote from the House committee report: "To assure that safety issues will be fully studied and subjected to unbiased tests the program initiated under the committee's bill will update the available information on emissions."

It is clear that Congress and the gas industry must continue to apply pressure to insure that the research appropriately sponsored by the Federal Government does in fact take place.

In conclusion, AGA is a firm supporter of natural gas use as a vehicular fuel, as a means to back out foreign oil, improve the environment, and most importantly, save consumers money. We believe that the Methane Transportation R. D. & D. Act provides a significant boost to the concept of natural gas use in vehicles. We hope to be able to work with DOE so that the needed Federal involvement is minimized. Where Federal involvement is needed we hope DOE and Congress will be supportive.

I appreciate the opportunity to make these remarks and I'll answer any questions.

[The prepared statement of the American Gas Association follows:]

WRITTEN STATEMENT
OF
THE AMERICAN GAS ASSOCIATION
BEFORE THE
SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS
OF THE
COMMITTEE ON SCIENCE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES
ON THE IMPLEMENTATION OF THE METHANE TRANSPORTATION RESEARCH,
DEVELOPMENT AND DEMONSTRATION ACT OF 1980
November 19, 1981

Introduction

The American Gas Association (A.G.A.) is a national trade association, which represents nearly 300 natural gas distribution and transmission companies serving over 160 million U.S. consumers in all 50 states. We are pleased to provide you with our industry's views on the implementation of the Methane Transportation Research, Development and Demonstration Act of 1980 (Pub.L. 96-512) (hereinafter referred to as the Act).

Natural gas currently provides about 27% of the energy consumed in the U.S. and more gas is produced domestically than any other fuel. Gas provides about 46% of all energy used in residential and commercial establishments in the U.S., and about 36% of the energy consumed by U.S. industry and agriculture. Unfortunately, gas supplies only about 3% of the energy consumed by the transportation sector. Although this represents 55 times more energy than is provided to this sector by electricity, it is far below the amount of energy supplied by petroleum -- 18 quadrillion Btu or nearly

97% of total energy consumed by the transportation sector in 1980.

While converting to natural gas all of the approximately 100 million vehicles in current operation in the U.S. is not feasible, we believe that the approximately 8 million government and commercial fleet vehicles represent a sizable market segment where natural gas can achieve significant acceptance. The use of natural gas as a transportation fuel offers our nation advantages when compared with other transportation fuels from a conservation, economic, environmental, safety, and supply standpoint. These advantages were a primary reason for A.G.A.'s active support of the Act from its introduction to the present. We are, therefore, very appreciative of the leadership provided by Chairman Dan Glickman (D-Kansas) in introducing legislation that became the Act, and his strong support for ensuring funding and implementation of the Act.

A conservative estimate of potential oil savings is that every million vehicles converted could back-out approximately 70,000 barrels of imported oil per day. Thus, complete saturation of the 8 million fleet vehicles in current use would displace roughly 560,000 barrels of oil per day -- reducing oil imports by about 10%.

In addition, the consumer benefits greatly by conversion. Consumers are now apparently willing to spend between $8,000 to $12,000 to purchase a new automobile with increased gas mileage. For this investment, savings between $400 and $600 could be expected. Conversion to natural gas, on the other hand, costs between $1,000 and $1,800 and allows savings of $300 or more per year.1/ Furthermore, the consumer benefits from increased longevity of motor parts

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1/ Based on annualized costs of natural gas and compression of $.90 per gasoline gallon equivalent; 10,000 miles driven per year; and $1.20 per gallon of gasoline.

due to using natural gas instead of gasoline. Experience has shown that spark plugs needed to be changed only after 65,000 miles. Taxicabs in Las Vegas have run on natural gas for as long as 400,000 miles before the body -- not the engine -- deteriorated.

The A.G.A. is active in promoting the marketing of natural gas as a vehicular fuel. As part of this activity, A.G.A. has developed a marketing plan which is attached. This marketing plan points to several reasons -- in addition to backing-out foreign oil -- as to why the concept of vehicular use of natural gas should be considered.

- Supply: A considerable supply of natural gas is available today and the outlook is bright well into the next century. As residential and business conservation increases, even more gas will become available. New markets must be found for these supplies.
- Technology: Compressed natural gas and liquefied natural gas have been used with success in motor vehicles in the United States for over a decade. In Europe, natural gas has been used as a motor vehicle fuel for over forty years. As with all technology, there is room for improvement; but the fact remains, natural gas as a vehicular fuel is a proven concept.
- Environment: Natural gas is clean burning, substantially reduces motor vehicle emission pollution, and is non-reactive, (i.e. does not form smog.)
- Economic Recovery: With the recent slump in the economy which has significant effects on the U.S. automobile industry, it would be in the best national interest to emphasize a program that would improve the utilization of the existing manufacturers and existing skilled workers.
- Load Balancing: Privately owned vehicles are used more often during the summer months, which coincides with both the time when the natural gas distribution industry has the most surplus capacity, and the time when most environmental concerns are greatest. Therefore, from an overview, there is an ideal match with the environmental concerns, delivery concerns, and national interest concerns served by the use of this technology.

With regard to terminology, it is important to note that the terms "methane" and "natural gas" are used interchangeably in this statement. Methane is the primary component of conventional natural gas, but can also be derived from various unconventional and renewable resources.

DOE Implementation

A.G.A. has been generally disappointed with DOE implementation activities thus far. DOE recently released a draft study entitled "Assessment of Natural Gas Application to Automotive Vehicles", which was prepared under contract by the Aerospace Corporation, El Segundo, California. While we were encouraged by the effort to pull together a large amount of data and information on natural gas as an automotive fuel, we expressed several general and specific shortcomings of the report. In general, we believe that the draft report:

- Provides inadequate insight as to the inherent advantages of methane powered vehicles, and often portrays natural gas in an unnecessarily negative manner;
- Fails to address recent developments in research and development, particularly in the area of storage containers;
- Fails to address institutional barriers and, therefore, makes no research recommendations concerning them; and
- Needs further development of current and future economics of the major competing fuels in the transportation market.

In addition, we made several specific comments relating to technical errors made in the study -- errors that indicate a level of expertise in this area that could be improved through further input by the natural gas industry and equipment manufacturers.

This study does not adequately meet the goals expressed in the Committee Report to research and assess safety, environmental quality, petroleum savings, or the economics of conversion and operation.

A.G.A. has also been disappointed by the DOE and the Administration budget requests for implementing the Act. Despite the Act's authorization of up to $3 million in FY 1982 and $5 million in FY 1983 and FY 1984, the Administration has recommended that no funds be appropriated. We will continue our efforts to inform the Administration as to the national advantages of funding the Act. In this regard, we are gratified by the efforts of this Subcommittee to ensure that $500,000 is made available in FY 1982 under the DOE Alternative Fuels Utilization Program for research and development of natural gas as a vehicular fuel. We hope that the Administration, in its efforts to continue reducing oil imports, will allow funds to be used as directed by the Act in FY 1982. We also hope that funding is provided in FY 1983 and FY 1984 and pledge our support to that end.

We believe that it is important to develop alternatives to petroleum. It is, moreover, inequitable to fund methane research at a level so far below that of electric vehicle research, especially given the greater potential of natural gas fueled vehicles.

Just last week, DOE proposed a rule to implement Section 6 of the Act regarding research and development activities.2/ We have not yet examined this proposed rule fully but two comments are in order:

- This proposed rule was due, under the Act, on February 13, 1981;
- DOE stated that the only reason the rule was being proposed at all was its statutory obligation under the Act.

2/ 46 Fed. Reg. 55627; November 10, 1981.

It is this last point -- showing the continued lack of interest at DOE -- which made the Act necessary in the first place.

A.G.A. will be submitting comments to DOE on this proposed rule. Our comments will strongly support the concept of and the need for research in certain areas.

Needed Activities

A.G.A. does not understand the continued opposition of DOE and the reticence of the Administration to fund and implement the Act. A program which enhances conversions to natural gas would dovetail with our national policy to back-out foreign oil -- particularly oil from nations with interests inimicable to those of the U.S.

In addition, needed governmental involvement is small -- although very significant. The Act allows governmental research and development in those areas where private sector activity is supplemented, but no governmental activity is allowed if it would "supplant" or "duplicate" private activity. The private sector is very aggressively involved in research activities. Governmental involvement will, therefore, be necessarily limited to areas where the government is uniquely qualified. Such involvement would include, but not be limited to:

- Research into the relative safety of natural gas as a vehicular fuel as compared to other fuels including gasoline;
- Research and assistance in development of National Fire Protection Association comprehensive safety standards;
- Research and assistance in developing standards compatible with Canadian vehicles;
- Advanced research of storage containers so as to increase storage capacity -- and vehicle range -- and to decrease the weight of storage cylinders;

- Research and study of institutional barriers restraining development of natural gas use in vehicles; and
- Continued air quality research on emissions.

The question of institutional barriers is particularly appropriate for federal government involvement, because many of the barriers exist as a matter of statute or regulation. In this regard, H.R. 2348, introduced on March 5, 1981 by Chairman Glickman is a positive step in that it would help to eliminate uncertainty as to how a manufacturer would calculate average fuel economy under the Motor Vehicle Information and Cost Savings Act when some automobiles produced by that manufacturer are powered by non-petroleum fuels.

DOE should be actively involved in identifying and removing institutional barriers. The A.G.A. has established a new gas industry-wide Methane Powered Vehicles Systems Committee. This committee will be very willing to work with DOE in such an effort.

Institutional barriers already targeted are:

- Potential problems under the Natural Gas Act which may cause local distribution companies to be subject to FERC jurisdiction if gas is sold in interstate commerce to a service station "for resale".
- Current restrictions limiting the use of gaseous-fueled vehicles in tunnels.
- The DOE research funding imbalance between electrically powered vehicles and gaseous fueled vehicles.

Conclusion

A.G.A. has been and remains a strong supporter of natural gas use as a vehicular fuel as a means to back-out foreign oil, improve our balance of payments, improve the environment and develop new markets that are not sensitive to weather. As a part of this commitment, A.G.A. will be sponsoring a major conference on Methane-Powered Vehicles on May 5-7, 1982. We are also firm supporters of the Methane Transportation Research, Development, and Demonstration Act of 1980 and recommend that this Subcommittee continue its efforts to appropriate funds for the Act

A MARKETING PLAN
FOR
METHANE POWERED VEHICLES

I. EXECUTIVE SUMMARY

Converting cars and light trucks to use natural gas in a utility's fleet is attractive in the 1980's because of the economics and current gas supply situation. Natural gas is easily adapted to use in automotive engines designed to use gasoline. The octane rating of methane is 130 which allows it to be substituted for any grade of leaded or unleaded gasoline. The conversion kit contains add-on items, and installation is relatively simple. Several suppliers offer such kits. Normally, no internal modifications are made to the vehicle engine, ignition or cooling systems. A fuel selector switch is installed on the dashboard. The conversion kit is easily transferable from old vehicles to new ones at trade-in time. The only other change required is installation of storage cylinders to contain the compressed or liquefied natural gas, in the vehicle.

The marketing of methane powered vehicles (MPV) will usually result in favorable effects on gas industry sendout, fleet owner economics, reduction of oil imports, and a cleaner environment.
Although there are about 100 million vehicles in operation in the U.S. today, the approximate 8 million fleet vehicles represent the market segment where the MPV concept can achieve immediate significant acceptance.

The concept is such that it requires an economic analysis be done for each case. Local conditions should be reflected in each analysis.

Finally, to embark upon a successful marketing program, several actions must be taken by the natural gas industry from a national perspective, and individually by each utility to reflect local nuances.

Note--The terms natural gas, methane, and CNG will be used interchangeably in this analysis, since natural gas is composed almost totally of methane. CNG and LNG will denote compressed natural gas and liquified natural gas, respectively.

II. SITUATION ANALYSIS

A. Background

As a result of the ill effects of the imbalance of trade payments caused by increasing quantities and price of oil imported into the United States, and the air quality effects of gasoline burned in the internal combustion engine, the nation continues to focus on the urgent need to develop new kinds of transportation fuels. This is currently one of the most hotly debated and least understood emotional issues facing Americans. The price of gasoline escalated dramatically in recent years and its availability in abundant quantities is sometimes questionable.

Ideally, the substitution of a complementary fuel would use the same technology infrastructure as the displaced fuel, to minimize dislocations in the process of reducing imported oil. The use of methane in motor vehicles offers an ideal solution to the question of substitution.

For political and economical reasons several issues must be considered if a massive switch to methane powered vehicles is to take place:

a. Supply: A considerable supply of natural gas is available today and the outlook is bright well into the next century.[1] As residential and business conservation increases, even more gas will become available. New markets must be found for these supplies.

b. Technology: Compressed natural gas and liquified natural gas have been used with success in motor vehicles in the United States for over a decade.[2] In Europe, natural gas has been used as a motor vehicle fuel for over forty years. As with all technology, there is always room for improvement. But the fact remains, the MPV is a proven concept.

c. Environment: Natural gas is clean burning and substantially reduces motor vehicle emission pollution, thereby meeting present EPA guidelines.[3]

d. Imported oil: Assuming that a vehicle uses 1,000 gallons of gasoline a year (a low estimate), then each one-hundred thousand vehicles converted to MPV's will result in the reduction of approximately 7,000 barrels of imported oil per day. If as few as one-quarter of all U.S. vehicles were converted, the potential savings would be nearly 1,750,000 barrels a day. This would help reduce the imbalance of foreign trade payments. This number represents the maximum potential. It is felt that this would significantly help to control world oil prices and domestic inflation.

With the recent slump in the economy, which has significant effects on the U.S. automobile industry, it would be in the best national interest to emphasize a program that would improve the utilization of the existing manufacturers and existing skilled workers. Privately owned vehicles are used more often during the summer months, which coincides with the time when the natural gas distribution industry has the most surplus capacity, as well as a time of most environmental concern (i.e., smog). Therefore, from an overview, there is an ideal match with the environmental concerns, delivery concerns, and national interest concerns by the use of exploiting this technology.

For years, in connection with the natural gas system, engines have operated satisfactorily on methane (natural gas). These are usually engines which operate pumps, compressors, generators, and other oil-field and gas-production equipment. Such engines are also used to operate gas compressors which are part of the nationwide gas distribution pipeline system. Because of the recent public interest in energy, pollution, and inflation, methane is now being reconsidered in certain automotive markets. This was originally done, in the U.S., during the late 1960s; however, because of the national gas supply situation at that time, it was not emphasized. There are approximately 20,000 vehicles presently operating on methane in the United States.[2]

Special methods of fuel handling and storage are required to apply methane to motor vehicles. We are all familiar with the ease of handling gasoline. It can be pumped and metered with inexpensive equipment. It can be stored in underground tanks at relatively low costs. The tanks in the vehicle can be at atmospheric pressure, and therefore, can be of thin-wall construction. Methane is somewhat more difficult to pump, store, and meter. Because the automobile will retain the ability to run on gasoline, there is fuel flexibility in which the driver can use either gasoline or methane at any given time. The operation of a CNG vehicle is as follows (see figure 1): Natural gas is compressed to 2,400 PSI and is placed aboard the vehicle through the natural gas filler line (5), where it is transferred to high pressure cylinders permanently installed in the rear of the vehicle. When natural gas is required by the engine, it leaves the cylinders (1), passes through the master manual shut-off valve (2), the high pressure fill line (3), and enters the engine compartment. At this point the natural gas enters the pressure reducer (6). Here the pressure is reduced from 2,400 PSI to atmospheric pressure. The solenoid valve is used to shut off the natural gas supply when the engine is not running or when it is being fueled by gasoline. If the natural gas solenoid is opened, the natural gas passes through the pressure reducer into a specially designed natural gas mixer (8), where it is properly mixed with air, flows down through the gasoline carburetor (7), and enters the engine's combustion chambers (kits are also available for fuel injection engines and diesel engines). The gasoline supply to the gasoline carburetor is controlled by the gasoline solenoid valve (9) which shuts off the flow of gasoline when the vehicle is being run on methane. A fuel switch selector (4) is provided so that the operator of the vehicle can select fuel from either the CNG fuel system or the gasoline system. This generalized description is similar for all the systems being used within the United States as well as New Zealand, Australia, and Italy.

Methane powered vehicles are in wide spread use in New Zealand.[4] In fact, the New Zealand government has set as a goal the conversion of 150,000 vehicles to CNG by 1985. The Italians have over 40 years experience with methane powered vehicles and currently have over 250,000 of them in operation.[5] Obviously the cost of gasoline and the first cost of automobiles have been a significant driving force in both of these countries. As a result of the clean burning properties of methane it is estimated that the cars will last nearly 300,000 miles thus, reducing the cost per mile significantly.

B. Market Size

Although the total potential demand for methane powered vehicles is every motor vehicle in the United States, it would be best to target the initial market in an evolutionary way. First, motor vehicle fleets; second, locations where a large number of cars collect; and third, on private automobiles. The total market potential for cars to be equipped with conversion kits to allow them to run on methane is virtually every car in operation in the U.S. which numbers approximately 100 million vehicles. About seven percent of the vehicles or about seven million are fleet vehicles. Characteristics[6,7] of these fleets are:

Sector	Annual Miles	Average Daily Miles	Average Fleet Size
Police	33,000	132	506
Government	17,000	68	1,428
Utilities	12,000	48	137
Taxis	57,000	228	31
Auto rental	18,000	72	1,040
Business 25+	27,000	108	205
Business 4-24	26,000	104	205
All sectors	24,000	96	230

From a pure economic standpoint, taxicab fleets represent the most desirable market. Additional considerations suggest that utilities be the first target for the expansion of this market with the others following, depending upon availability of gas and economics within each service area.

Gasoline is being sold at approximately $1.10 per gallon, wholesale, which is equivalent to approximately $10 per million Btus including a 14% efficiency advantage for CNG fueled engines. The average national commercial rate for methane is approximately $3 per million Btus. This varies from area to area and will have an impact upon the economic viability of the conversion of fleets from gasoline to a dual fuel capability. Other factors, which will be discussed later, that impact on the economic viability are: local prices; codes; labor costs; cost of money, state, local and federal taxes; and insurance.

However, there are other social and operating economics which will have some significant effects: for example, the longer operating life of a vehicle when it is operated on methane, the reduced maintenance cost, the promotional value cost of operating a clean, economical environmentally benign system, and the security of fuel supply in the event of another gasoline shortage, should also be considered.

Utilities operate 7.8 percent of the total of fleet vehicles with an average fleet size of 137 vehicles. For A.G.A. members this would represent an approximate total of 40,000 fleet vehicles, or 5 million Mcf, or fuel cost savings of $17.8 million, plus an improve ment in the gas utility load balance -- in essence increasing send out equivalent to 32,500 residential customers on a national basis, and reducing operating costs. This obviously has to be offset with other factors. There are approximately 7 million fleet vehicles in the United States. If all were converted, the total usage of methane would be about 1.2 Tcf or 6 percent of our total production in the U.S. in any given year. It would increase revenues by approximately $3.7 billion a year. As was previously mentioned, this is significantly less than the amount of gas that is being conserved since 1975. In other words the reduction in send out per meter by the gas utility business far exceeds this amount on an annual basis. This is well within the means of the utility industry to supply this energy comfortably within its present system.

There are approximately 210,000 employees in the natural gas industry. If one assumes, due to mass transportation, carpools, etc., that one in three drive their own car to work, the result is a potential market of 70,000 automobiles that could be converted to dual fuel capability (i.e., $15 million in increased revenue). The general characteristic of many of these employees is that they drive their automobile from their home to the office; it then spends the majority of the day in a parking garage or parking lot. If facilities could be provided to service these vehicles, there is a potential increase of gas sales of approximately $30 million. If phone companies, manufacturing facilities, etc., wanted to provide this service or have it provided to their employees, a conservative estimate of 1,000,000 vehicles in this category is reasonable.

Not very far down the road, is the potential for the private auto being refueled by a small residential compressor.

At this time the initial market that seems practical is the 7 million fleet vehicles. The 70,000 vehicles driven by gas utility employees and the approximately fourteen times that amount for employees of other utilities such as electric, telephone, water companies, large industrial firms, plants etc., could bring the total up to approximately 8 million vehicles. It is extremely difficult, at this early stage, to estimate what the ultimate market penetration would be. This will depend significantly on relative prices of energy and other factors which will be discussed later.

C. Factors To Be Considered

In other to determine if there is an economic incentive to aggressively go after this market, the following factors must be considered:

1. First costs--including: Engineering
   Construction
   Equipment
2. Relative costs of transportation fuels
3. Operating cost savings
4. Service life
5. Salvage value
6. Proportion of equity financing
7. Proportion of debt financing
8. Interest rate
9. Debt amortization plan
10. Opportunity cost
11. Method of tax depreciation
12. Income tax rates
13. Return on investment
14. Other local costs
15. Fuel supply security

In the first market segment (gas utility fleets) it may be decided that the first hand experience, favorable impact on load factors, the PR benefits, etc., may have enough value to proceed with a rate of return not usually acceptable.

Each of the fifteen points should be considered carefully. Many of the issues will not apply in all cases. For example, code and standard requirements in one jurisdiction may be costly and not exist in others. These local nuisances must be dealt with specifically.

Of particular note to the Gas Industry is the opportunity costs. Since 1973, gas sales have declined by nearly 2 Tcf even though the name of customers has increased by about 4 million, in the same time frame. This means that the $62 billion of capital investment in the gas industry is not being fully utilized. Moreover, the conservation trend is expected to continue. For this and other business reasons, it is imperative that the gas industry look to new markets for better utilization of its existing system.

The economic payouts reported by some organizations using methane powered vehicles varied from as low as 6 months to an average of 3-4 years. It should be noted that there are scenarios where the conversion is not economically viable. From the data in hand, this seems to be the exception and not the rule. For illustrative purpose, two example evaluations are presented in Attachment A. Methane, when used as a transportation fuel, can play a key role in reducing carbon monoxide emissions. Methane, or natural gas, emits negligible amounts of carbon monoxide when burned as a transportation fuel. Our rough calculations indicate that a methane vehicle will emit 2.53 grams per mile less CO than a gasoline powered vehicle. HC and lead emissions are also reduced, therefore, for every 1000 fleet vehicles converted to natural gas, from gasoline, carbon monoxide emissions would be reduced by 60 tons per year (assuming normal fleet use of 22,000 miles/year/vehicle).

The clean burning attributes of methane can be used in public and private transportation to reduce CO levels in nonattainment regions. Carbon monoxide emissions from a gasoline powered vehicle are 2.6 grams/mile.[8] CO emissions from a natural gas powered vehicle are significantly lower at about 0.1 grams/mile.[8] In addition, the use of natural gas would have a positive effect on those factors that must be considered in developing measures to meet the Basic Transportation Needs (BTN)of the clean Air Act.[9] Specifically, the use of natural gas in public and private vehicles will reduce fuel and maintenance costs while improving safety and personal security.

The use of methane vehicles to reduce air pollution is neither new or novel. There have been a number of studies conducted over the last fifteen years that have looked at the use of methane in automobiles and buses to reduce air pollution. In 1973, EPA Administrator William Ruckelshaus suggested the use of methane vehicles as a pollution abatement option for Los Angeles. In an early position paper (circa 1972), entitled "Conversion of Motor Vehicles to Gaseous Fuel to Reduce Air Pollution", the Environmental Protection Agency advocated reducing urban air pollution through the fleet use of methane powered vehicles.

D. Strengths and Weaknesses

A) The concept (see attachments B[9] and C[10]) has many advantages over competing technologies especially electric powered vehicle technologies. These include:

1. Cost of conversion
2. Operating range
3. Dual fuel capability
4. System is reusable when vehicle retired
5. Technology is present state of the art
6. Vehicle performance is similar to gasoline
7. Methane has a 13-14% efficiency advantage over gasoline
8. Combustion is more complete
9. Engine life, spark plug life, and maintenance costs

are improved with CNG thus resulting in less emissions

10. More than 94% of methane comes from domestic resources
11. MPV uses the existing vehicle infrastructure
12. Operation of MPV is not weather sensitive
13. Does not rely on scare minerals as do the electric powered vehicles with lead, nickel, and cadmium used in batteries
14. Generally a significant reduction in fuel costs
15. Security of supply

B) The shortcomings of the concept are few and usually minor. These include:

1. Additional weight to vehicle
2. The need for multiple cars to make the concept feasible
3. The unfounded perception of some that gasoline is safe, when, in fact, CNG is much safer than gasoline
4. The need for front end investment to enable the system to be installed
5. The training necessary for operation and maintenance

The strengths are definitely in the majority. The conclusion from this is that an opportunity exists that should definitely be given serious consideration.

III. OBJECTIVES

The objectives of the successful establishment of a methane powered vehicle market by utilities in their service area are:

1. Develop new non-weather sensitive load
2. Enhance utilization of delivery systems
3. Improve rate of return
4. Perform a public service function by aiding in the reduction of air pollution
5. Aides in the reduction of oil imports
6. Improve the image of the natural gas industry

IV. ACTION PROGRAM

To create a climate for the use of natural gas in this new non-traditional market, a multi-faceted program will have to be initiated, both from a national perspective and by individual gas utilities.

Nationally, the gas industry should:

1. Form a Methane Powered Vehicle Systems Committee (MPVSC) to be responsible for the identification and appraisal of utility, commercial, and private markets for methane

powered vehicles; and the development of national goals, strategies, and action programs, including training to achieve and retain desired shares of the transportation fuels market. (This committee is now being formed by the American Gas Association).

2. Provide, through the MPVSC, data indicating the size of fleet vehicle registration by state.
3. Develop training programs to enable gas industry personnel to become familiar with technology and methods of determine economic and practical viability.
4. Develop a government contact program to address the following areas:
    a. The development of a MPV demonstration program through DOE
    b. Develop a program to achieve the road tax exemptions such as those enjoyed by gasohol
    c. Determine what, if any, federal or state regulations apply to the resale of natural gas
    d. Support a Congressional funding effort for methane transportation research and development and demonstration (RD&D)
    e. Address onerous ordiances such as those preventing gaseous fuels in road tunnels
    f. Develop a general understanding of the oil import reduction that can be realized with MPVs
5. Develop a standard economical evaluation procedure to be used by utilities and others to evaluate the concept in a consistent manner.
6. Develop a coalition to support MPVs by emphasizing the benefits such as:
    a. Automaker--The concept of utilizing traditional technology
    b. Labor unions--The concept will utilize the present factory lines and labor force
    c. Auto dealers--MPVs will not interfere with the infrastructure in place thereby capitalizing on the present distribution of vehicles
    d. Mechanic--The MPV is the same as a regular vehicle, with dual fuel capability
7. Promote the concept--through articles, speeches, papers and advertsing, --- to fleet owners, the auto industry and the public.

8. Develope a gas industry policy position regarding the pros and cons of selling unregulated gas at a public methane refilling station.

On a local basis, the gas distribution utility should do the following:

1. Put together a task force to evaluate the benefit to the utility of converting all or part of their fleet to MPVs.
2. Develop a marketing strategy to offer the methane powered vehicle concept to major fleet operators in their service area. It should include the identification of fleet characteristics such as fleet size, daily mileage driven, need for truck space and night parking location.
3. Determine other potential markets such as school buses, agricultural, community, industrial uses, etc.
4. Evaluate the steps necessary to establish exemptions from state and local road and sales taxes.
5. Promote the positive image of methane powered vehicles to the public (i.e. safety, economics, cleanliness, efficiency, and national interest, etc.).
6. Take steps necessary to assure a favorable rate is approved by the Public Utility Commission.
7. Keep abreast of technological, congressional, and regulatory developments.

Attachment A

Methane Fuel for Motor Vehicles

Financial Analysis

Assumptions

1) One gallon of gasoline contains about 125,000 Btu; selling price in 1980 of $1.30 per gallon equals $10.40 per million Btu. Forecasted prices are escalated at 3% annually excluding inflation.
2) Price of natural gas assumed at $2.50 per million Btu. Road Use Tax of $1.00 and variable costs of $.80 are included in $4.30 price. Forecasted prices are based on A.G.A.'s demand model (TREA-II) analysis of about 9% increase through 1985 and 7% increase through 1990, excluding inflation.
3) Extensive testing in New Zealand concluded that methane has efficiency advantage over gasoline from 5% to 40% with an average of about 13-14%.
4) Mileage increase assumes continued improvement in fleet efficiency from new car replacements. Forecasted mileage gains are from data in Gas Guzzler Tax legislation.
5) Sample fleet for this anlysis includes 100 cars which are driven 100 miles per day, 250 days a year.
6) Capitalized cost includes 4 compressors at $30,000 each, 2 storage cylinders per car at $400 each and conversion kit at $525 each including installation. Sales tax of 4% brings total cost to $262,600. For tax purposes, double declining balance method is used with a 10 year life.
7) Assume total project is financed with debt at 12% interest. Annual cash flow (line 32) is used to retire debt.
8) Investment tax credit of 10% on 90% of expenditures.
9) Annualized rate of return on cash flow at the end of each year.

First Costs

The three cost components for converting vehicles to natural gas are: 1) purchase of a compressor, 2) purchase of storage cylinders, and 3) installation of dual fuel capability. Two cylinders would be required per car to extend driving range to 100 miles. If the range exceeds 100 miles without opportunity to refuel CNG, one or more storage tanks would need to be added. Total first costs for 100 cars would be:

Compressors	+	Storage Cylinders	+	Conversion kits and Installation
(4 x $30,000)	+	(2 x 100 x $400)	+	(100 x $525) =

Sales tax at 4% would bring the total fixed cost to $262,600 or $2,620 per vehicle. Purchase of substantial quantity of equipment could well result in economies of scale with reduced cost per vehicle.

Relative Cost of Fuels

The cost of 1 million Btu's of energy in gasoline is $10.40, assuming $1.30 per gallon and 125,000 Btu per gallon. Also, natural gas has a 13.14% efficiency advantage over gasoline because of three reasons: 1) no need for an accelerator pump, 2) more complete combustion, and 3) higher octane rating.

Fleet Assumption

This analysis considers using compressed natural gas in a pilot project involving 100 cars. Fleet assumptions are:

Average daily mileage per vehicle	100 miles
Total days usage per year	250 days
Average gasoline consumption	15 miles per gallon

If total annual mileage is greater than 2.5 million miles (100 miles per day x 250 days), the annual fuel savings would increase. Annual natural gas consumption for these fleet assumptions would be less than 20 million cubic feet assuming 1000 Btu per standard cubic foot.

Variable Costs

The cost of natural gas for the utility in this example is estimated to be $2.50 per Mcf or million Btu. Based upon 1979 annual report, the cost was less than $2.00. The cost in 1980 (and potentially including some cost of service items) would raise the cost from the 1979 level. If the $2.50 cost approximates sales to industrial customers, the concept could be extended to providing dual fuel capability and natural gas sales to customers with a fleet of vehicles.

Maintenance expense and overhead are assumed to be the same as that of gasoline and not pertinent to this analysis. Indeed, experience indicates that vehicles can be driven further between oil changes and spark plug replacements. A $1 per million Btu Road Use Tax needs to be considered. A variable cost of 80¢ per million

Btu is assumed to cover compression costs and other unquantified expenses.

The cost of a million Btu of natural gas to power the car would be:

Natural Gas	+	Road Use Tax	+	Compression Costs
$2.50	+	$1.00	+	$.80 =

$4.30 per million Btu, equivalent to 54¢ per gallon of gasoline.

Savings

Therefore, the savings for fuel expense is $6.10 per million Btu ($10.40 less $4.30). This savings equals 76¢ per gallon or 5.1¢ per mile at 15 miles per gallon. In addition, natural gas has a 13-14% efficiency advantage which increases the savings per mile to 5.8¢. The first year of fuel savings would be $145,000 (2.5 million miles x $.058) This amounts to a 1.8 year simple payback.

Return on Investment

After considering ITC, depreciation, interest and income taxes, the payback is slightly less than 3 years. Over the first 5 years, the after-tax return on investment would be about 20%. This would be a very attractive investment.

The major uncertainty in forecasting return on investment is the relative prices of gasoline vs. natural gas. The gasoline prices have increased dramatically over the past 2 years, principally due to OPEC influence. Assumption for future gasoline prices are anyone's guess but they will definitely increase. The natural gas prices will increase as well but not at the same rate as oil.

For purposes of this analysis, A.G.A.'s assumption regarding crude oil price increase was used and gasoline prices were increased by 3% annually, excluding inflation. A.G.A.'s estimate of industrial natural gas prices increases at about 9% annually until 1985 and at 7% through 1990, excluding inflation. As a result of these assumptions, the savings in using natural gas over gasoline remains relatively constant in 1980 dollars. If gasoline prices or import taxes have the effect of increasing the gasoline price at the pump faster than 3%, the return on investment would be more attractive. The attached schedule and assumptions represent a ten year projection for savings, an income statement, cash flow, and return on investment.

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METHANE FUEL FOR MOTOR VEHICLES
FINANCIAL ANALYSIS WORKSHEET
SCHEDULE
(1980 $)

	1	2	3	4	5	6	7	8	9	10	TOTAL
Fuel Cost Comparison											
1. Price of Gasoline per MMBtu[1]	10.40	10.71	11.03	11.36	11.71	12.06	12.42	12.79	13.17	13.57	
2. Price of Natural Gas per MMBtu[2]	4.30	4.68	5.10	5.56	6.06	6.48	6.94	7.43	7.95	8.51	
3. Savings per MMBtu	6.10	6.03	5.93	5.80	5.65	5.58	5.48	5.36	5.22	5.06	
4. Savings including 13% efficiency[3] per MMBtu	6.89	6.81	6.70	6.55	6.38	6.31	6.19	6.06	5.90	5.72	
Energy Consumption											
5. Average Fleet Mileage MPG[4]	15.0	16.5	18.0	19.5	21.0	22.5	24.0	26.0	28.0	30.0	
6. Gallons of Gasoline for 2.5MM miles[5] (x 1000)	166.7	151.5	138.9	128.2	119.0	111.1	104.2	96.2	89.3	83.3	
7. MMBtu of Gasoline[6] (x 1000)	20.833	18.939	17.361	16.026	14.881	13.890	13.021	12.019	11.161	10.417	
8. Annual Fuel Savings (line 4 x line 7 (x 1000))	143.54	128.98	116.32	104.97	94.94	87.64	80.60	72.84	65.85	59.58	955.26
Income Statement (x 1000)											
9. Depreciation[7]	53	42	34	27	22	17	17	17	17	17	263
10. Interest[8]	32	18	8								58
11. Taxable Income (line 8 - line 9 + 10)	58	70	74	76	73	70	64	56	49	42	631
12. Income Tax @ 46%	26	32	34	35	20	18	30	26	22	19	245
13. ITC[9]	(24)										(24)
14. Net Income (lines 11 - 12 - 13)	55	48	40	41	53	52	34	30	27	33	410
Return on Investment (x 1000)											
15. Cash Flow (line 14 + line 9)	108	90	74	68	75	69	51	47	44	50	676
16. Cumulative Cash Flow		198	272	340	415	484	535	582	626	676	
17. Internal Rate of Return[10] (%)			2.0	12.4	19.3	23.2	25.2	26.5	27	28	

ATTACHMENT A

TABLE 7-9. CHARACTERISTICS OF ALTERNATIVE VEHICLE FUELS

	Methanol	Ethanol	CNG	LNG	Hydrogen	Electricity
Cost						
Vehicle (from gasoline master)						
o Modify	$900	$900	$1,700*	$1,700	--	--
o Production	Negligible	Negligible	$1,700*	$ 100	--	--
Fixed (fleet situation)			$1,000 Only per car	included in fuel cost	--	--
Operating Fuel (gasoline equivalent)	$.90	$1.80	$.45	$.60	--	$2.00
Technical						
Installed weight (pounds)	Negligible	Negligible	240	125	750	800-1,000
Range (miles)	400	400	100	360	27	50-150 (less in cold weather)
Drivability	Good (cold weather starting problems)	Good	Good	Good		

*Dual fuel (natural gas and gasoline) now in production.

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ATTACHMENT C

(11) How do CNG vehicles compare with electric vehicles? Very favorably. For example:

ITEM	CNG VEHICLE	ELECTRIC VEHICLE
Cost of conversion	When the system is added to a gasoline vehicle - $1,000/vehicle plus installation costs	Not feasible to convert an existing gasoline vehicle without a major retrofit. (average New $12000)
Range	CNG - 60-100 miles Gasoline - Unlimited	40 - 60 miles on a charge
Cost of operation per mile	At 55¢/gallon and 12 miles/gallon - 4.6¢/mile	4 - 5¢ per mile
Alternate fuel capability	Gasoline	None
Recharge Time	Fast fill - 5 minutes Slow fill - Overnight	Fast charge - 30 minutes Slow charge - 8-10 hours
Can the fuel system be transferred to a new vehicle?	Yes, with minor expense involved	Not readily since it is an inherent part of the vehicle
Fuel storage system and replacement time table	Cylinders - Some similar types of cylinders have been in use over 70 years. Hydrostatic tests cost $15 every 5 years.	16-20 six volt batteries - they will need to be replaced every 2 - 4 years at a cost of $60/battery for a total cost of $960-$1,200.
Simple payout period	3 - 4 years Sometimes as low as 6 months on high usage vehicles	Difficult to predict due to $12,500/vehicle cost when handmade. In volume perhaps $8,000/vehicle
Additional weight added to the vehicle	Approximately 130 pounds/cylinder in rear of vehicle. This is of great help on slick streets in winter.	Batteries weigh 1,260 lbs.
Safety of fuel system in event of a collision	Natural gas is lighter than air and if leakage should occur it dissipates into the atmosphere.	Dependent upon protective construction.
Vehicle performance characteristics	Very similar to gasoline	Very similar to gasoline
Passenger capacity	Any size gasoline vehicle can be converted to CNG	2 - 5 passengers

REFERENCES

1. American Gas Association, "The Gas Energy Supply Outlook 1980-2000," October 1980.

2. J. Winston Porter and Morton Grosser, "Prospects for Using Natural Gas in Light Transportation Vehicles," Prepared for Policy Evaluation and Analysis Group, American Gas Association, December 1978.

3. R. D. Fleming and J. R. Allsup, "Natural Gas As an Automotive Fuel, An Experimental Study," U.S. D.O.I./B.O.M. Report of Investigations 7806, Bartlesville Energy Research Center, Bartlesville, Oklahoma.

4. L. G. Brown, "C.N.G. and Vehicles," The Australian Gas Journal, March 1979.

5. R. N. Abram, A. L. Titchener and J. P. West, Report of Overseas Visit to Investigate Compressed Natural Gas in Italy, Report No. LP 2202, Liquid Fuels Trust Board, New Zealand, February 1980.

6. D. B. Shonka, "Characteristics of Automotive Fleets in the U.S. 1966-1977," Oak Ridge National Laboratories, Oak Ridge, Tennessee, September 1978, for the U.S. DOC.

7. J. R. Wagner, "Fleet Operator Databook, Volume 1: National Data," prepared for U.S. DOE at Brooklane National Laboratory, Upton, New York, September 1979.

8. American Gas Association, Energy Analysis, "A Comparison of Alternative Synthetic Fuel For Light Vehicles," June 11, 1980.

9. Environmental Protection Agency's (EPA) and the Department of Transportation (DOE) Notice of Proposed Policy and Guidance on Meeting Basic Transportation Needs (BTN) as required under Section 110 (a)(3)(d) and 110 (e)(5)(6) of the Clean Air Act - 45 Federal Register 62170, September 18, 1980.

10. Gas Service Energy Corporation, Kansas City, MO, Compressed Natural Gas (CNG) a "Here Today" substitute for Gasoline Equipment, Technology, System Design.

11. General Motors Corporation, Warren, Michigan, Phase I Urban Energy Assessment Report for Anaheim California", GM Transportation Center, July 30, 1980.

Mr. **Glickman**. First of all, I want to thank you, not only your testimony, but for your innovative and aggressive expansion of this fuel in the markets in the central part of the United States and for the American Gas Association's leadership generally in this area.

I guess my first question is one that you answered at the end. That is, here you are, a businessman involved in the private sector, but you don't rule out the role of the Federal Government in providing some research and development help in connection with this new technology. Do you think it's necessary to continue?

Mr. **LaLonde**. Yes, sir.

Mr. **Glickman**. And obviously, you don't want the Government to build the cars or to become actively involved in the operations of the system. I guess what I'm really trying to say is that it's refreshing to hear that the private sector is not afraid to come up here once in a while and say that they have no ideological aversion to any federal cooperative role in the development of an energy technology. And I guess my word is, cooperation, doing it on a nonconfrontational basis.

Mr. **LaLonde**. That's correct, and it's up to the Federal Government to set the proper environment. And part of that environment is to establish research and, in fact, carry out some research. Some of that is in the area of the institutional barriers which government has created and therefore government is the logical party to make some change or decide that no change should be made. But what we need is to have the understanding of the American public that this concept is perceived as something that's in the long-term American interest.

If I could comment on one item that was brought up earlier, and that has to do with gas supply. It seems to me that we have focused our attention here on, not the real issue. In the 1920s the U.S. Coast and Geodetic Survey came out with its first forecast of supply of the oil industry, and at that time it said we had 8 to 9 years' supply. Today that forecast still reads that we have approximately 8 to 9 years' supply of oil.

Now, these forecasts were based on proven reserves. Our technology and scientific understanding says that there are a lot of potential reserves. Now, that's quite the same for natural gas.

The potential for natural gas is in the neighborhood of 930 to 1,160 trillion cubic feet. Now, that's a figure put out by the same USGS. And at the same time DOE says that our proven reserves are in the neighborhood of 200 trillion feet. The reason for the difference is simply that a proven reserve has to be drilled, piped, tested, and ready to produce. A potential reserve may be in the same field, but if it doesn't meet a very stringent test, then we do not put it in the proven reserve category.

The point being that you only have proven reserves to the extent that they're economically affordable by the producer. We could drill it all up and say, aha, we now have a firm handle on 1,000, 1,100 trillion cubic feet of gas, but the cost of keeping that in the ground when it isn't produced would make them uneconomical over their life. So consequently, we have focused on what is the present economic life of the reserves and with today's interest figures, 6 years is almost a point where it's uneconomic to keep your money in a well that isn't producing.

Mr. Glickman. What about cost of the gas? Mr. Shamansky raised that issue. Whether we deregulate completely now or whether we do it by 1985, I suspect that's going to happen. And Mr. Shamansky says the cost differential will not be anywhere where it is. I wonder if you might comment on that?

Mr. LaLonde. Well, the cost that was noted earlier by Dr. McGeer of approximately 90 cents including the compression cost, for gas which could be sold to an individual, has in it, of course, all of the components, and one of those is the cost of the natural gas itself. If the cost of natural gas doubles and it's currently priced at about $4 an MCF in that 90-cent figure, if it doubled to $8 an MCF, the price would go to $1.30 per equivalent gallon.

Mr. Glickman. So the price of gas would not double then?

Mr. LaLonde. No, sir.

Mr. Glickman. Just the cost to the consumer?

Mr. LaLonde. The cost to the consumer would not.

Mr. Glickman. If we deregulate it today, what would happen to the immediate cost to the consumer? Would it double? What you're saying is, it wouldn't double.

Mr. LaLonde. What I tried to say is that, if we assume that the average cost of gas is approximately $4 today per MCF and let's assume that it went to $8 per MCF, and those are figures which are within the ballpark of immediate deregulation, it would add approximately 40 cents per equivalent gallon to the cost of compressed natural gas.

Mr. Glickman. So we'd still be below the equivalent price of gasoline, then?

Mr. LaLonde. Yes, sir.

Mr. Glickman. Even with the compression costs?

Mr. LaLonde. That's right. What's made it kind of an awkward situation is that where we had gasoline at $1.50 a year ago, it can be bought in my area for as low as $1.08, and it makes the savings very slim. But on the other hand, you've pointed out very candidly Saudi Arabia's position, and they can influence that price up to $2.00 very suddenly, and then the saving is immense. So our position is that we have to get on with the cost of involving this technology, developing the infrastructure which is not there for the dispensing of the fuel, and for those people where it's economic they will start it. And as the infrastructure develops and as the cost relationship between oil and gas begins to normalize, we will find that it will be a cost- cost-effective program for many, many people.

Mr. Glickman. You've answered in your testimony a lot of the questions that I had. Do you have a listing, does the AGA have a listing, by country, of the number of vehicles currently converted? That would be useful for the record of the Committee.

Mr. Cole. The AGA does not have a list of that nature at this point. We have organized a Methane-Powered Vehicle Committee within the AGA organization recently. I will have to examine their plans for the future to determine if they are in fact, going to be looking at that issue.

Mr. Glickman. You know, I don't believe that any energy alternative is magic, not even natural gas. However, it does come as close as any that I've seen in this country, and it is fundamentally amazing how few people are familiar with the concept. And so, having that kind of information is useful, I think, to Members of Congress.

Mr. **Cole**. I think we have heard testimony concerning the DOE report, for example, indicating there is about 250,000 vehicles operating in Italy, somewhere around, oh, we'll say 20,000 in New Zealand. There are considerable numbers of vehicles. We've seen figures up to half a million in the world. We're also interested in that.

Mr. **Glickman**. My final question is this, both Dr. McGeer and yourself refer to dual-fuel vehicles. Is it your feeling that we ought to be moving as a general proposition for the consumer, to the dual-fuel capability, rather than the single-fuel capability? And can you design an engine that can do both reasonably efficiently?

Mr. **LaLonde**. The answer to both questions is, "Yes." We have always been of the position that compressed natural gas or liquefied natural gas is not the forever solution to the automotive problem, nor is it the solution for everybody's vehicle, because there are some vehicles that it is cost ineffective, and there are others that the kind of use that the vehicle has makes natural gas unattractive. Consequently, gasoline or diesel fuel may always be the alternative from an economic point of view. We feel that the emphasis should be on developing the capability and it will find its niche in the marketplace and if it's encouraged enough where it really makes sense is the use by commuters in everyday back-and-forth driving where the range of natural gas that is added to a car is sufficient for that kind of usage. And that represents somewhere in the neighborhood of probably 85 percent of all of the passenger vehicle-miles that are driven within the 10 or 15 miles of where a person lives. And that's obviously the target market which compressed natural gas has. We have no illusions of being able to fill up and run in from Kansas City to Chicago without a refill, some 550 miles. That's not what we're looking for. That is a market which will forever be served by gasoline or diesel fuel. But with a combination or a dual-fuel capability, the person has the attractiveness of everyday economy of natural gas for short hauls and the flexibility of gasoline or diesel fuel for the long trip.

Mr. **Glickman**. And, of course, fleet use is most practical because of its centralization of distribution. I assume that is a major market you are pursuing?

Mr. **LaLonde**. Yes, and again, most of your fleet use is intracity. The intercity trucking business is an entirely different fleet market and that requires some significant research, although it does have some promise.

Mr. **Glickman**. Mr. Dunn.

Mr. **Dunn**. You talked in your testimony about traveling around the country to cities and owners of fleet vehicles and that they came away impressed with the cost savings, but they had a great deal of hesitancy and didn't go along with purchases of the equipment because of "concerns with Federal approval." I'm not sure what you're getting at. If you can prove to them that it makes economic sense, I don't know of too many businessmen who'd say, well, I don't see the tacit approval of the Federal Government so I'm not going to do this. Are you referring to the infrastructure that isn't there, or their concerns with safety? I'm not sure what you were saying to me.

Mr. **LaLonde**. First of all, let's talk about the public agencies. With a public agency, it's easier to get a new vehicle appropriated which will give you 50- or 80-percent improvement in gasoline mileage than it is to put an add-on unit onto that car and save yourself the same 50 or 80 percent in the operating cost. The reason is that it's new, and public agencies are a little bit reluctant to be the trial balloon in case something doesn't work. And the only people that they really have to rely on right now are companies like ourselves and others in the gas industry that you'll hear from later who may be perceived as having a self-fulfilling prophecy. So, as we get some local companies that do have faith in their gas distributor to try it out, then the acceptance by other members of the municipal and county government structure is greater. And that's a growing trend. But if there was a good solid stamp of approval that the Federal Government has tried this, it's an acceptable technology and they endorse it heartily, then that institutional or perceived institutional barrier is broken down. That is one of the things we're talking about.

Now, for an individual, they are saying, well, gee, I want an assurance that I'm going to have a cost saving in 3 years, but I don't know what is going to happen to the gasoline prices and I think the Federal Government is going to double the price of natural gas by having it deregulated. So they are saying, I'm just going to sit back and wait and see what happens.

Our position, to people in the private sector as well as to the municipalities, simply is that under the present scheme of allocation of the Department of Energy, should there be a shortage of gasoline, there are a lot of governmental functions that have no allocation. There are a lot of businesses that have no allocation priority for gasoline, and they are out of business. There is no allocation given, in priority, for garbage collection gasoline, as an example. Now, just think of Washington, D.C., if you didn't pick up the garbage for 3 weeks. So, there are these kind of things that we are hoping that the Government will recognize, that there is a reason to have the alternative energy source and capability in place, rather than saying, well, gee, we can always put it in when it's there, because the infrastructure to develop storage cylinders and the marketing system and the fueling system just can't be built up that quickly.

Mr. **Dunn**. But there's nothing in the regulations—I guess. A different question—one of my cities just bought 12 new buses. There is nothing in the regulations that I was reading from the Department of Transportation that would have prevented that city from buying buses that also run on methane.

Mr. **LaLonde**. No, but there probably is a regulation precluding the use of that kind of fuel on schoolbuses.

Mr. **Dunn**. No, these were city buses.

Mr. **LaLonde**. But if those city buses carry schoolchildren under any kind of subsidy, there are some limitations, State by State.

Mr. **Dunn**. OK. Well, that was my second question. What about the safety aspect?

Mr. **LaLonde**. Well, the safety aspect, we can find no evidence of a serious problem, and I unfortunately left at home a little article that came out of a paper in Oklahoma where they had put some natural gas in their police vehicles and one of the police vehicles was rearended by an erratic driver and it provided a very nice crash test that we weren't expecting. The photocaption was, the natural gas system remained intact, but the gasoline tank was split open and leaked all over.

[The information referred to follows:]

[From the Tulsa World, Nov. 3, 1981]

STILLWATER VEHICLES BURN GAS NATURAL-LY

(By Tom Purdom)

STILLWATER.—If another gasoline shortage hits the nation, drivers of many municipal vehicles in this town of 31,000 can drive by lines of impatient motorists and laugh.

In an innovative move earlier this year, Stillwater began installing devices that enable 25 city-owned vehicles to operate with compressed natural gas, the stuff that's flared-off as waste at oil wells.

The city is the first in Oklahoma to make the switch and one of 30 in the nation.

Bob Sisson, assistant city manager, said the compressed natural gas systems has been installed to save Stillwater money.

Sisson projects that $50,000 to $70,000 a year can be saved.

"It was a bold move by the city commission," Sisson said. "They took federal revenue sharing funds that could have been spent on other projects and decided to venture into an energy savings project."

The project began as a cooperative effort between Sisson and Gary Holland, a technology agent for the Oklahoma State University Cooperative Extension Service and the Community Technology Initiatives Program.

"I looked into propane and a few other methods," Holland said.

"There wasn't much information out on compressed natural gas, but the more I looked into it, the better it became."

The clincher came, Holland said, from a city staff trip to Greeley, Color., where municipal vehicles use compressed natural gas. "They were very . . . very impressed," he added.

Sisson said city commissioners were hesitant, at first, to accept the proposal to switch to compressed natural gas.

"I guess you cold say there is a natural fear of the unknown," he explained.

The fear was overcome, though, and the city authorized $100,000 for the project.

Today, along with the traditional gasoline pump in the city maintainence yard, there is a compressor hooked to a system of gas cylinders.

And instead of the fat, black pump hose there is a small round hose that hisses natural gas instead of squirting gasoline.

Converting the nine police cars, 10 garage trucks and five utility trucks "was really pretty simple," said Holland,who added that conversion kits cost $1,200 each for the police cars and $1,600 each for garbage trucks.

"Any vehicle that burns gasoline can be converted to burn compressed natural gas," Holland said.

Since compressed natural gas burns cleaner than gasoline, vehicle maintenance costs have been reduced 37 percent, Sisson said.

"And since natural gas is less expensive than gasoline, we'll realize even more savings there," he said.

Stillwater purchases processed natural gas from Oklahoma Gas & Electric Co.

Even more savings may come "sometime down the road," said Holland as he pointed to an oil well with a natural gas flare-off not more than 100 yards from the natural gas compressor.

"We tried using unprocessed gas from the well in the system but it got gummed up," Holland said. "We're working with an OSU professor now to come up with an economical way of processing natural gas ourselves . . . and we're close . . . very close."

The well, on city-owned land, is owned by a private firm that now flares off natural gas. "We've got an understanding with them that we can have the gas," Sisson said. "Now all we have to do is find an economical way to process it and we won't have to purchase gas from OG&E."

While the system sounds good, there are drawbacks.

"We had to overcome some skepticism of police officers," said Lt. Dick Little.

While the average motorists could not detect it, cars using compressed natural gas have a bit less acceleration than those using the conventional fuel.

That's why the police cars have both gasoline and compressed natural gas tanks.

It takes less than two seconds for an officer to switch from compressed natural gas to gasoline, and the officer can do it with one finger in the comfort of the police car.

"About 95 percent of our patroling is just regular city driving, so we use the compressed natural gas for that," Little said. "If an officer gets in a pursuit situation, all he has to do is switch back to gasoline."

There was also a fear by police officers, of the gas cylinders blowing up in a wreck.

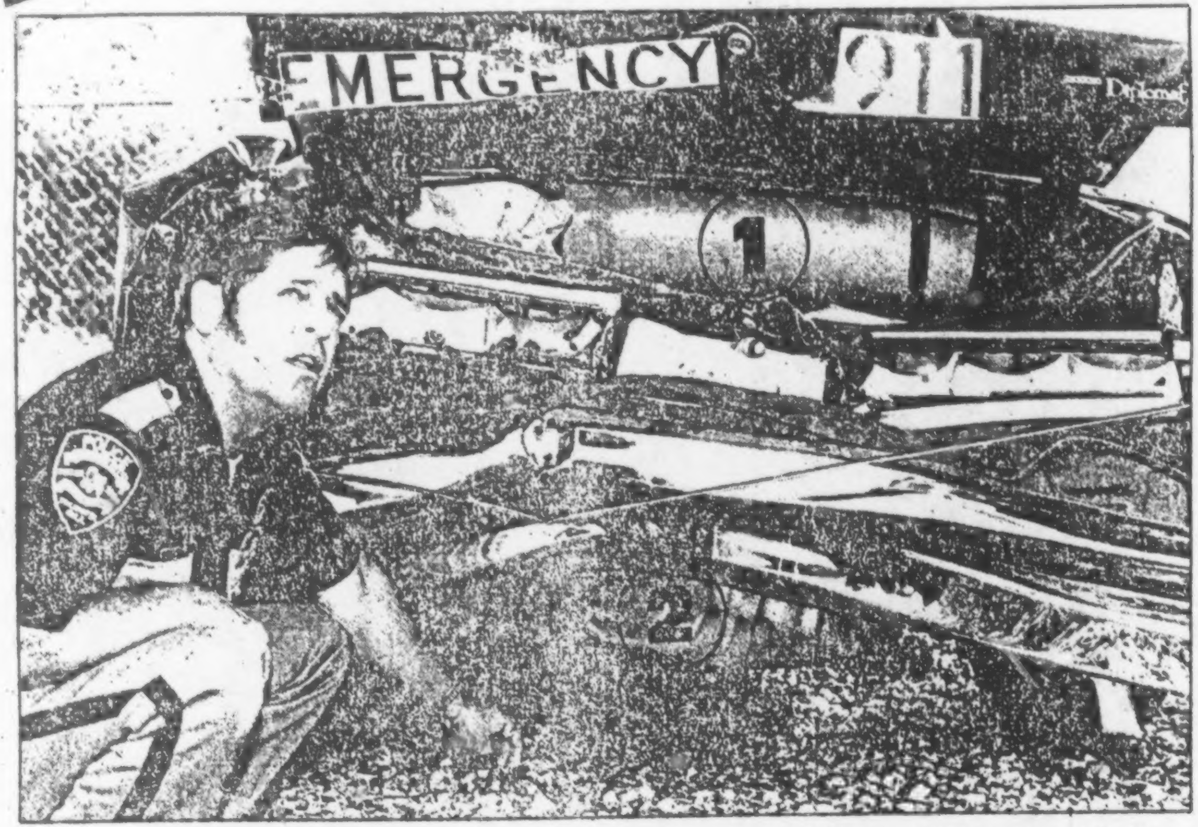
The fear was dispelled two weeks ago, literally by accident, when a police car was rear-ended by a drunk driver, Sisson said.

"The gasoline tank ruptured but the compressed natural gas tanks (there are two cylinders in each car) came through without a scratch," said Little.

Sisson said the system appears to be working better than expected at this time. He added that other municipalities and even farms could adapt their vehicles to compressed natural gas.

In fact, Holland is in the process of completing a computer study on the system that will ease the way for other cities to adapt to compressed natural gas.

"I personally think this is the best kept secret to date," Holland said.


EMERGENCY
911
Diplomat
1
2

Lt. Dick Little examines police cruiser that was struck from behind. The natural gas fuel tank (1) was not scratched by the impact. The gasoline fuel tank (2) was punctured.

Mr. **Carney**. Did it explode?

Mr. **LaLonde**. The gasoline?

Mr. **Carney**. Yes.

Mr. **LaLonde**. No, fortunately there wasn't enough source of ignition. But the point was that you had a greater potential for explosion and fire from gasoline than you did from natural gas. And that has been proven in every situation that we've known. We've rolled over trucks with this, and I have a copy here which I will leave with you of that incident. We have rolled over trucks where we have totally shattered the gasoline tank and——

Mr. **Dunn**. No, but I mean, one of the stumbling blocks you face that you're continually worried about is the question of safety? Is that still a big stumbling block to someone purchasing the equipment? They don't believe it's safe?

Mr. **LaLonde**. We think we can defuse that, but it takes a lot of work.

Mr. **Dunn**. No, I'm not arguing whether you can or cannot. I'm asking the question, is that still a public perception?

Mr. **LaLonde**. Yes, sir.

Mr. **Dunn**. Is that an area in which you would need some help from the Government?

Mr. **LaLonde**. Yes, sir, very much so. It's a perceived drawback; very much.

Mr. **Glickman**. Even though I think tests by the Coast Guard and the Department of Transportation and others show that gas disperses and is less flammable than gasoline. The public still perceives a bottle or a canister as hazardous even though it may in fact be less of a problem.

Mr. **LaLonde**. And the reason for that, quite simply, is that there have been a number of incidents, and they read one about every 2 or 3 weeks, about liquefied petroleum or propane cylinders, and they are much more suspect in terms of safety.

Mr. **Dunn**. I was asking that because you were talking about problems of the role the Federal Government could play.

Mr. **LaLonde**. Yes, sir, that's the kind of thing we're talking about. And if the safety aspect and environment can be a positive one set by Government, I think that's a big institutional barrier that could be broken down.

Mr. **Glickman**. Mr. Carney, glad to have you here.

Mr. **Carney**. I'm sorry I wasn't here. We were having our acid rain hearings at the other committee room. Your talking about barriers and perceptions, I think the first thing that one would have to do is to make it legal for one to drive a vehicle that was powered by compressed gas through such areas as the Baltimore Harbor Tunnel, the Holland Tunnel, and so forth. I didn't have an opportunity to hear all the witnesses, but I understand that it was stated that it would cost about $250,000 per unit to put in place refueling stations.

Mr. **LaLonde**. I think the estimate related to what it would cost to put in the compressor capacity and the quickfill storage capacity to equip a public fueling station to handle as many as 60 cars a day on a public fueling basis.

Mr. **Carney**. In other words, the $250,000 cost would be what you might want to call a retrofitting cost? We're not talking about establishing a new station, land and property values and everything else?

Mr. LALONDE. The figure that was referred to, I believe, was the cost of establishing a service station where you'd pick up your fuel. We don't agree that that is the cost, because we think it's lower. But I have not had time to inspect that particular number so I'm not going to comment on it. All I know is from our figures, we can provide a fueling station for substantially less funds than that. Our figure is that it's costing in the neighborhood of $1,500 to $2,000 per vehicle that you want to fuel at a public station. So if you brought in 60 cars a day to fuel with natural gas, we would see an investment of between $90,000 and $120,000.

Mr. CARNEY. Well, there certainly is a substantial difference between the testimony of another gentleman, who said it was $250,000 for a 60-car-per-hour station.

Mr. LALONDE. OK, if it is 60 per hour, that's something else, and I'm not ready to comment on that number.

Mr. CARNEY. And you say that you can do it between $1,500 and $2,000 per car that you would want to refuel per day?

Mr. LALONDE. Right now that's the number we're looking at. Now, we haven't looked at something which would fuel more than that because—the per unit cost would go down, because the cost of the compressor goes down radically as the size of the compressor goes up. That's the biggest cost involved with refueling stations is the cost of the compressor.

Mr. CARNEY. The point I was trying to get across is that the general drawback, as I see it, is that there is no availability of places to refuel. I have an RV vehicle on which I utilize compressed gas, not for driving it but for heating and air conditioning, and it is just one solid pain in the neck to go through the process of fueling that vehicle. There is not readily accessible methods to refuel that.

Mr. LALONDE. We agree and we think that, and the first person that testified this morning made the point, that something has to be done in terms of Government action to stimulate the startup of the infrastructure to provide this. We always look at it as a private enterprise that under the existing tax laws and everything else we have to make this thing work. And it's a very high entry fee if we have to use existing depreciation rates, even the new ones or our existing tax laws. It's much the same as a city that wants to decide to get into urban redevelopment. They may give a builder a 10-year grace period on paying taxes to make it attractive for him to go in and clear out the land and redevelop and carry that until it's a profitable activity. I think what's necessary is that private industry is not unwilling to put up the money to establish these public fueling stations, but we certainly can't see it if we can't get a clear policy out of the Federal Government that it endorses the concept of making sure that America has a good alternative fuel system to gasoline. Without that stamp of confidence, it's very difficult for us to put a whole industry out there which is foreign, if you will, to our normal way, because people today perceive the fact, well, gee, we're always going to have cheap gasoline, because we have a glut. Well, we have a glut today because we've got a depression going on, worldwide. And people aren't buying energy, and people in jobs today don't know where they're going so they don't travel in their car, they're saving those gasoline dollars.

Mr. **Carney**. What you're saying, then, is that you need a stamp of approval for the concept from the Federal Government. So you're in an area where the psyche of people will be more acceptable to this alternate energy resource?

Mr. **LaLonde**. That's the biggest thing that will help this industry to move along. And that was the purpose of this bill last year, was to start to get the Government involved so that they would come up with positive recommendations. And I believe our stumbling block here has been, we've been slow in developing those positive recommendations.

Mr. **Carney**. Well, you have the bill now, right?

Mr. **LaLonde**. We have the bill but——

Mr. **Carney**. Now what do you want?

Mr. **LaLonde**. You read the context of the Department of Energy statement and that's almost to the point of, gee, you know, we can tell you all the things that's wrong with this, but even despite that we've got customers all over the United States and other people have customers all over the United States that want to buy this, but we have a problem with the public perception that the Government really isn't seriously interested.

Mr. **Glickman**. Will the gentleman yield for 1 minute on that?

Mr. **Carney**. Yes.

Mr. **Glickman**. I just might tell you that earlier this year the Department of Energy floated another bill up here which would have repealed this law together with about every other alternative energy bill that has been enacted. Now, you can argue the merits, philosophically, I think they were coming from the point of view that the private sector should do it all. I would point out, in addition, I read earlier on that in the Federal Register when the Department of Energy promulgated regulations under this act, it basically said, we don't really want to promulgate these regulations because we don't like the law.

Mr. **Carney**. I think the chairman realizes—so as not to cloud the issue—I was a cosponsor of that bill and I was glad to be, too. It's the Congress that makes the decisions and not the Department of Energy. So I don't fully understand, I mean, what do you want us to do? We can get 218 signatures on a thing that says, yes, we as the Congress accept that alternate energy resource. Now there is a new thought in the entire Nation and private industry is going to go in and start doing it. I don't believe that, I really don't. I think private industry is looking for financial help, looking for research help and assistance from the Federal Government. I think your statement was somewhat of an oversimplification.

If private industry thought we could solve this by an expression of support, let's go right ahead and let's get a sense of the Congress resolution supporting me than as an alternate energy resource. I think we can get 218 signatures before we close the first session of the 97th Congress. In fact, I'll start it, and if we can get that then you'll have what you want and there's no sense conducting a hearing.

Mr. **LaLonde**. I think it goes a little more than that. We haven't——

Mr. **Carney**. Sure it does. That's the point I'm trying to bring out.

Mr. **LaLonde**. We're not asking in this hearing to have an enormous appropriation. What we're asking is that there are certain gaps that have evolved within the infrastructure and within the regulated structure that need addressing and it's the responsibility in my estimation of Government to address these things. As for instance, there's a very big issue under the Natural Gas Act of 1938 as whether all the sales of a public fueling station operator are "sales for resale." Now, if you do that, you're going to create a bureaucratic monstrosity because you're going to get every gas company in the country now under Federal regulation, and we're not about to do that. So that that's an issue that has to be clarified.

You have this thing with the ability to go through tunnels, and over certain bridges with a cylinder of gas, to ride on the streets of New York City and in some parts of Boston. Now, those are things which Government must address if they're willing or wishing to have this program of alternative fuels go forward.

We're not asking for Government to underwrite the cost of a public filling station. We'll take that as a profit-based center and try to make a go of it, and if we fail we're going to lose money, but if we're successful we'll get a reward for it. We're not asking for capital to underwrite that thing. But we are saying that we have to make sure that we get reasonable tax understanding for this kind of a business. We don't want to be saddled with something that affects, that we're placed in another kind of industry because it's a heavy good.

I'm a utility man, and the tax law is fine, but in terms of the ratemaking process, we still have 35- and 40-year life to live with in terms of setting our rates. And if these gasoline station replacements with natural gas stations are going to be treated by utility commissions as utility businesses, there's no way we can make it work if we have a writeoff of 40 years on equipment. Those are the kinds of things, and without going into detail.

Mr. **Carney**. You're suggesting there that the public service commissions and the Federal Government would look at a refueling station as a utility?

Mr. **LaLonde**. Well, there's a lot of people that would like to. And we're trying to say those——

Mr. **Carney**. Are you suggesting that present law would do that?

Mr. **LaLonde**. Well, the present law isn't clear as to where the jurisdiction of selling gas ends from a regulatory point of view. I'm only saying that that has to be clarified.

Mr. **Carney**. You now operate an automobile that's fueled with compressed gas, is that correct?

Mr. **LaLonde**. Yes, sir.

Mr. **Carney**. And where do you get that refueled?

Mr. **LaLonde**. I happen to have a compressor at my house. Where'd I get it? From the company. And since it's a company-owned vehicle, we buy the gas and we own our own compressor. We're not selling compressed gas.

Mr. **Carney**. May I ask what the company is? I'm sorry.

Mr. **LaLonde**. This is the Gas Service Co., of Kansas City. We're a natural gas distribution company.

Mr. **Carney**. OK, so that particular company, then, is controlled by Public Service?

Mr. **LaLonde**. That's correct. But if we now decide, as in Chairman Glickman's territory, there's a company which is not a utility that's operating a public fueling station, and they buy gas from us. Now, our question is, are they a public utility? Nobody's willing to say yea or nay on the subject. That's the kind of thing which we're talking about is we have to get some clarification from Government on these kinds of issues so that we can go forward with our own economic planning.

Mr. **Carney**. You're a public utility because you're in the retail business, right?

Mr. **LaLonde**. Yes, sir.

Mr. **Carney**. Now, if that person didn't buy it from you and went back to your source, is your source controlled by a public service commission?

Mr. **LaLonde**. No, it's controlled by the Federal Energy Regulatory Commission. They're both directly or indirectly covered under the Natural Gas Act, and what the question is, that this is a sale of natural gas and in theory it's absolutely controlled under the provisions of that act. Practically speaking, we're saying we don't think it should be, and it doesn't make sense to. That's the kind of thing we're asking, in terms of institutional barriers, should be corrected, and I think it's the Federal Government in this case that has the only authority to make those corrections.

Mr. **Cole**. Might I add a comment, also? Bill has commented on the need and has recognized the need for Government support in this area. I think we could break Government support in various pieces. Congress has certainly demonstrated its support of this concept by the legislation that has been passed. And we would ask that Congress continue to husband the interests of these technology developments, in activities that are at the agency level. We're very interested in seeing this concept continue to grow and we would ask that you help us husband those interests in the agencies that have jurisdiction and have a regulatory effect over the development of rules, regulations and attitudes toward the use of methane vehicles in this country.

Mr. **Carney**. That's all.

Mr. **Glickman**. Thank you, Mr. Carney. I appreciate your testimony and sometime I think that we need to pursue it, regardless of the current Department of Energy's position on some of these philosophical issues. I've found one of the most useful things I did was getting the former Secretary of Energy under the previous administration to drive one of these cars. Their interest perked up rather dramatically and I think it might be useful to get some of the key administration people more personally familiar with the technology. It would not be as abstract to them, I think.

Mr. **LaLonde**. We can certainly work to arrange that right here in the Washington area.

Mr. **Glickman**. OK. Thank you both.

Mr. **LaLonde**. Thank you very much.

Mr. **Glickman**. Our last witness is Mr. Filiatrault, Executive Vice President of the Northern Illinois Gas Co. It's a pleasure to have you here. You've been contributing to some of the testimony already. You know a lot about the subject matter. We appreciate having you here. Your entire statement will appear on the record, and you may feel free to summarize as you wish.

STATEMENT OF EDWARD FILIATRAULT, EXECUTIVE VICE PRESIDENT, NORTHERN ILLINOIS GAS CO., AURORA, ILL.

Mr. **Filiatrault**. Thank you, Mr. Chairman, and members of the committee.

Hearing your statements on the merits of natural gas, I wish you were a salesman for us on many occasions. NIGas does welcome this opportunity to appear before you today and express our views on methane-powered vehicles and to express our views on the Methane Transportation Act and how the act itself has or has not affected conversion to using methane as a vehicle fuel.

I, like Bill LaLonde, speak as a driver of a methane-powered vehicle and as the officer of my company who's had responsibility for our conversion efforts.

Northern Illinois Gas itself is the Nation's fifth largest natural gas distributor, serving over 1,440,000 customers in the northern third of Illinois excluding the city of Chicago. We have been active in methane-powered vehicles for the past 3 years and we have a conversion program in place within our own company where our goal is to ultimately have our company fleet operate on methane. We have also been very active in contacting our over 1,400 fleet operators in our area. We have made some sales and many others are pending.

Mr. LaLonde's company is a supplier of ours in terms of conversion kits.

We as a nation have approximately 20,000 methane-powered vehicles. The world count is in the 300,000 to 500,000 range, as was discussed earlier this morning. So you can see that we as a nation are considerably behind the rest of the world in this effort. The advantages of the conversions have been pointed out by others.

One of the main barriers to a more rapid conversion is the fact that no vehicles come with methane equipment on them as original equipment. Each methane vehicle that currently is operated in the United States today has had to have been retrofitted at a cost of approximately $1,500 per vehicle for the retrofit, and as Bill LaLonde testified, approximately another $1,500 to $2,000 for fueling systems.

We have had discussions with certain of the auto manufacturers regarding the need, the industry's need to have methane equipment on vehicles as original equipment. These auto manufacturers feel that the vehicle recertification program that they have to operate under is a significant barrier to providing methane equipment as original equipment. Each revision that's made to a model automobile subjects the total automobile to a total recertification and the costs here are well in the hundreds of thousands of dollars.

They would like, obviously, some knowledge of what the market really is going to be before they expend those kinds of dollars for recertification.

Mr. **Glickman**. Certification with whom?

Mr. **Filiatrault**. I don't know all the specifics on it, but they have a vehicle certification process that they have to go through, a federally mandated program.

Mr. **Glickman**. OK, with various Federal agencies, DOT, DOE, you name it.

Mr. **Filiatrault**. Right. And I think Congressman Dunn probably is quite familiar with that. I think, if the certification program issue were addressed, it definitely would be in accordance with section 2(b)(3) of the act, which had stated, "facilitate and remove barriers to the use of methane-fueled vehicles in lieu of diesel or gasoline fuels."

Once vehicles do become available on the market, the fueling infrastructure itself will develop in time, and previous testifiers spoke to that. But right now we have this chicken-egg situation. Which really comes first, getting the vehicles on the road or getting the fueling system in place to handle them?

As a distributor we encounter another institutional barrier, and that is the Hinshaw problem that Bill LaLonde spoke to. I go into some detail in my testimony on a specific situation there and if I may I would like to read that, please, because I think with the help of our lawyers we put it down in a manner which, hopefully, is helpful.

As long as the CNG is used directly by a distributor or one of its direct customers, our lawyers feel that we have few if any regulatory problems. The problem which we'd like to direct your attention to, however, arises when one of our customers desires to resell the CNG or methane to another party, as would be the case in a fueling station. A typical example may be helpful.

Assume a distributor such as us has an existing customer that is a municipality on our system and that municipality has undertaken the expense of constructing compression facilities and the retrofitting of its municipal fleet so they could utilize CNG. The neighboring municipality would like to avoid the expense of setting up a total refueling station and, therefore, would like to purchase the CNG from the first municipality. Our lawyers advise us that such a commonsense approach may be viewed by the Federal Energy Regulatory Commission as putting the distribution company, us, in this case, in a position that we're making a sale for resale of natural gas in interstate commerce. The result is that the distributor, we, in this case, would be subjected to Federal regulations under the Natural Gas Act along with the other interstate commerce regulations that apply.

We don't believe that you in Congress ever intended such a result, for two reasons. First, in the context of the present situation natural gas could be viewed as a feedstock in this case for CNG and treated as any other feedstock is under the Natural Gas Act. Thus, the last sale of natural gas would occur at the point prior to compression and treatment where the natural gas is sold to the first municipality, that is, when the natural gas passes through our company meter.

Alternatively, the question could be faced in light of the Hinshaw exemption to the provisions of the Natural Gas Act. As you know, most distribution companies such as NIGas are exempt from FERC regulation because of this Hinshaw amendment which in effect permits natural gas to be sold even for resale so long as the distributor receives its gas supply at or within the boundaries of a given State and in turn makes the sale within that same given State. Of course, then we are regulated by the State regulatory commission in that particular State.

In the example presented, even assuming that the sale by the first municipality to the second is a resale of natural gas, focuses upon the point of consumption. The vehicle could drive across a State line. What really is the point of consumption?

In returning to my example, the question becomes whether the gas is consumed at the point when it is delivered into the fuel tanks of the second municipality's vehicles, and we submit that logic and commonsense really dictate this point of view, as opposed to when it's burned in the engine. Moreover, this view has been supported in a 1979 opinion letter by the then General Counsel of FERC, Robert Nordhouse. It was a letter order and not a declaratory order and doesn't carry the full weight with the Commission that a declaratory order would however carry. And we as a company do plan to take steps with FERC to get such a declaratory order. But in the event, however, that we fail we may find it necessary to return to Congress for legislative relief on this issue.

We feel the advantages of CNG are so great, and this is one of the main stumbling blocks for a distributor such as us, and we definitely feel that it needs to be addressed.

As for the act itself, most of us view it as a very positive statement of policy by Congress to further the use of methane. However, that's what it really is, a statement of policy. In the field we have not seen the results of accelerated research into and development of methane vehicle design and related technologies as called for in section 2(b)(1) of the act.

So, in summary I feel there's really two main institutional barriers. One is the automobile recertification program, which I believe you should be talking with the automotive industry in more detail about, and the Hinshaw exemption problems from the Natural Gas Act.

Bill LaLonde also spoke of the bridge and tunnel safety problems which I feel should be addressed as well. It took over a year to get full EPA approval because of the types of conversion units that are going in. We're over that barrier, fortunately, and hopefully well on the road.

If these areas can be addressed in a timely manner we feel that conversion would take place in accordance with your intentions when you did, in fact, pass the act.

[The prepared statement of Mr. Filiatrault follows:]

TESTIMONY
OF
EDWARD J. FILIATRAULT
EXECUTIVE VICE PRESIDENT
NORTHERN ILLINOIS GAS COMPANY
BEFORE
TRANSPORTATION, AVIATION AND MATERIALS SUBCOMMITTEE
SCIENCE AND TECHNOLOGY COMMITTEE
UNITED STATES HOUSE OF REPRESENTATIVES

Northern Illinois Gas Company welcomes this opportunity to appear before you today to express our views on methane powered vehicles and to express our views on how the Methane Transportation Research, Development and Demonstration Act of 1980 (P.L. 96-512) has affected conversion of vehicles to using methane as a fuel. I speak as a driver of a methane powered vehicle and as the officer of my company who had responsibility for our program.

Northern Illinois Gas is the nation's fifth largest natural gas distribution utility serving 1,440,000 customers in the northern third of the state of Illinois, excluding the City of Chicago. We have been active in using compressed natural gas for company vehicles for the past three years. During the past year, many of our service area's 1,400 fleet operators have also expressed a great deal of interest in converting their fleet to methane. We as a nation currently have about 20,000 methane powered vehicles whereas the world count is over 300,000. Obviously we are behind the rest of the world in this matter. Being successful in methane conversion not only is a significant savings to the user but it obviously reduces our dependence on foreign oil imports.

One of the main barriers to a more rapid conversion is the fact that no vehicles currently are equipped for methane as part of their original equipment. Each methane powered vehicle has had to have been retrofitted at a cost of approximately $1,500 per vehicle.

Discussions with certain auto manufacturers have indicated that the auto certification program they must comply with is really an institutional barrier to providing methane alternatives as original equipment. As we understand their certification program, any modification to the vehicle subjects the total vehicle to total recertification. Again, as we understand these certifications, they cost hundreds of thousands of dollars. It certainly would appear to me that if the institutional barrier of recertification were eliminated or at least modified, then methane equipment would more readily come as original equipment. Details of this problem can best be obtained from the automobile manufacturers.

Once vehicles start becoming available on the market, the fueling infrastructure will develop. Currently there appears the paradoxical chicken and egg syndrome. Which comes first -- the vehicles or the ability to obtain fuel. Because of this situation, most of us who are involved with methane powered vehicles are concentrating on fleet operators. Here the operator puts in his own refueling system and does not have to rely on a fueling infrastructure.

Local natural gas distribution utilities encounter another institutional barrier as they get involved with fueling of vehicles -- namely their Hinshaw exemption from the Natural Gas Act.

As long as the CNG is used directly by a distributor or one of its customers, my lawyers tell me that we have few if any regulatory problems. The problem to which I would like to direct your attention, however, arises when one of our customers desires to resell the CNG to another party. A typical example may be helpful. Assume a distributor has an existing customer municipality in Illinois that has undertaken the not inconsiderate expense of constructing compression facilities and retrofitting its municipal fleet to utilize CNG. The adjoining municipality would like to avoid the expense of constructing its own compression facilities by purchasing CNG from the first municipality.

Our laywers advise us that such a common sense approach may be viewed by the Federal Energy Regulatory Commission ("FERC") as putting the distribution company in the position that it is making a "sale for resale" of natural gas in interstate commerce. The result is that the distributor could become subject to federal regulation under the Natural Gas Act.

We simply can't believe that Congress ever intended such a result for two reasons. First, in the context of the present situation natural gas should be viewed as a feedstock for CNG and treated as any other feedstock situation. Thus, the last sale of natural gas would occur at the point prior to compression and treatment where the natural gas is sold to the first municipality -- that is, when the natural gas passes through the company's meter.

Alternatively, the question must be faced in light of the Hinshaw exemption to the provisions of the Natural Gas Act. As you know, most distribution companies are exempt from FERC regulation because of the Hinshaw amendment which in effect permits natural gas to be sold, even for resale, so long as the distributor receives its gas supply at or within the boundaries of the particular state, the distributor is subject to state regulation and all of the gas sold by the distributor is consumed within the particular state. In this instance even assuming that the sale by the first municipality to the second is a resale of natural gas, the focus is upon the point of consumption. To return to my example, the question becomes whether the gas is consumed at the point when it is delivered into the fuel tanks of the second municipality's motor vehicles.

We submit that logic and common sense dictate this view. Moreover, we are supported in this view by a 1979 opinion letter of the then General Counsel of the FERC, Robert Nordhouse. We do not know if the Nordhouse view continues to be accepted by the FERC. We hope that it is and plan to take steps to encourage a formal acceptance of that view. In the event we fail, however, we may find it necessary to turn to Congress for legislative relief. Simply put, the advantages of CNG to the nation's economy must not be lost.

Transportation Research, Development and Demonstration Act itself, is viewed by most of us as a very positive statement of policy by Congress to further the use of methane as a vehicle fuel. However, it has primarily stayed as just a statement of policy. We in the field have seen little if any technical advances in equipment brought about by "accelerated research into and development of methane vehicle design and related technologies" as called for in the Act.

In summary, I feel there are two main institutional barriers to conversion to methane powered vehicles:

1. Automobile Recertification Program, and

2. Hinshaw exemption problems from the Natural Gas Act.

If these two areas would be addressed in a very timely manner, efforts towards conversion to methane powered vehicles would proceed in accordance with the intentions of Congress when they passed the Methane Transportation Research, Development and Demonstration Act of 1980 (P.L. 96-512).

I thank you for the opportunity to express our views.

Mr. GLICKMAN. Thank you very much for your excellent statement. I will take steps myself to contact members of the Energy and Commerce Committee to discuss this issue. As you well know, the regulation of natural gas is probably the most complicated area that Congress ever deals with and I'm not sure that you want us to muck around with it in the near future. But we may have to, and if we do, this is an issue that I intend to become involved in.

Mr. FILIATRAULT. Thank you very much.

Mr. GLICKMAN. You have several very influential Members of the House from your service area. By the way, it's one of your members, Congressman Yates, who was responsible for getting some money for the legislation to at least start some methane research. And I think that, perhaps, it's just something you ought to know about.

Yes, we'll try to work on this automobile recertification program. I suppose, from my perspective, these hearings have confirmed two things. One is, there is interest in this issue. Two, that part of the rationale for the recession right now, if not the major rationale, is the depression in the automobile industry. It has permeated our society and the issue we're dealing with now is an issue that indirectly is trying to rejuvenate that industry by trying to provide a reason to buy a car. And it relates obviously to the issues of energy independence.

I might just point out, I found even a better quote from Sheik Yamani. He said, in that same statement I read earlier today, As a result of the Saudi production and pricing policy, many major companies have been very reluctant to implement their energy substitution projects. This is in the interest of the Arab cause in that it restores the importance of oil.

If I wanted to lead him in a court case, I couldn't have had him say anything any more carefully than that. And I think that he has given us plenty of justification to move ahead, or at least to provide the option. As Mr. LaLonde said, I don't think anybody believes that natural gas is going to provide all the fuel for the transportation sector. But it may provide what I call the backup fuel, in the aggregate, that we need so desperately.

So, I appreciate your testimony. I think the subcommittee will continue to pressure the Department of Energy to be more aggressive in their dealing with thsee issues, and funding it to the extent that there are some moneys available. I recognize there are not a heck of a lot of funds available, so I have backed off in terms of pushing them ahead on expensive projects. But I guess it's a little bit of Dale Carnegie, the power of positive thinking. You can be positive in Government without having spent a lot of money on it. I guess that's what everybody is saying today is, let's get some thematic thinking, good positive thinking, and again, not be afraid to work cooperatively between Government and private sectors.

One of the things that I'm pleased with is that there are some people, as I said to Mr. LaLonde and I say to you, some people in the private sector who are willing to come in and say, Government is not all evil. You've got some sort of a constructive role.

Mr. FILIATRAULT. And I think Detroit has shown us time and time again that if there is an incentive there, they will respond and with the research and development activities and their capabilities, that they could put on this type of effort. If the other barriers were removed I think you would see this skyrocket.

Mr. GLICKMAN. Thank you very much. No further questions? The hearing is adjourned.

[Whereupon, at 11:37 a.m., the subcommittee was adjourned.]

APPENDIX

First Annual DOE Report to Congress on the Methane Transportation Research, Development and Demonstration Program

Department of Energy
Washington, D.C. 20585

January 5, 1982

Honorable Dan Glickman
Chairman, Subcommittee on
Transportation, Aviation,
and Materials
United States House of
Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

Under the provisions of Section 9 of the Methane Transportation Research, Development, and Demonstration Act of 1980 (Public Law 96-512), the Secretary of Energy is required to submit an annual report to Congress covering all activities being undertaken pursuant to the provisions of the Act. The First Annual Report has been completed, and it is my pleasure to provide the enclosed document in fulfillment of this requirement.

The Department of Energy would be pleased to respond to any questions or comments concerning the report.

Sincerely,

Guy W. Fiske

Guy W. Fiske
Under Secretary

First Annual Report to Congress on the Methane Transportation Research, Development, and Demonstration Program

This is the First Annual Report to Congress on the implementation of the Methane Transportation Research, Development, and Demonstration Act of 1980 (P.L. 96-512). The report is required by Section 9 of the Act and summarizes the activities undertaken thus far by DOE with respect to implementation of P.L. 96-512. In addition, certain information required under Section 9 and Section 4(c)(8) is contained in DOE's State-of-the-Art Assessment of Methane Vehicles, which is Appendix B to this report.

Background

P.L. 96-512 was enacted on December 12, 1980, and authorized funding to be appropriated to the Secretary of Energy to undertake research and development (R&D) activities and conduct demonstrations of technologies for methane-powered vehicles and related facilities used in fleet and farm applications. The Act authorized appropriations of funds up to $3 million in FY82, $5 million in FY83, $5 million in FY84, and additional unspecified amounts for FY85 and FY86. Not less than one-half of the FY82 through FY84 funds were to be used for loans to support vehicle demonstration projects. The current DOE budget request, reflecting the Administration's policies of allowing market forces to determine needs and having the private sector undertake near-term R&D, does not include funds to implement P.L. 96-512.

Summary of Activities

The Office of Vehicle and Engine R&D (VERD), under the Assistant Secretary for Conservation and Renewable Energy, has the responsibility for work related to implementation of the Act. In August 1980, prior to passage of P.L. 96-512, VERD sponsored a one-day workshop for industry and Government participants to discuss the key areas of interest and to identify pertinent topics for a DOE assessment of methane fuel for automotive fleet vehicles. In January 1981, this study was initiated in the areas judged to be most crucial. The objectives were to review the state-of-the-art of methane vehicle technology, compile existing data on methane-fueled vehicles as currently used, and identify areas where R&D work may be desirable. There were five assessment tasks undertaken in this study: (1) safety, (2) supply/economics, (3) energy efficiency for transportation systems, (4) emissions/fuel economy, and (5) end use/economics. A draft of the study report was prepared and distributed for review and comment to numerous people in industry who have expertise on the subject. Review comments have been received and are being incorporated into the final report, which will be submitted to DOE by February 10, 1982.*

Although no funds have been requested for implementation, work has been undertaken on several statutory requirements of the Act. The status of these requirements are:

Section	Requirement	Status
4(a)	By 2/1/81, designate the appropriate DOE entity to manage the methane program.	Office of Conservation and Renewable Energy designated.
4(d)(2)	Within 60 days of enactment, issue administrative regulations to assure that new R&D supplements, rather than duplicates, industry R&D.	Notice of Proposed Rulemaking issued 46 Fed. Reg. 55628 (Nov. 10, 1981) Appendix A.
7(a)	By 1/1/82, develop data assessing the the state-of-the-art of methane vehicles as a baseline for the demonstration projects.	Report prepared, Appendix B.

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* This report will be available in DOE's Freedom of Information Reading Room, Room 1E-090, Forrestal Building, 1000 Independence Avenue, SW, Washington, D.C.

The demonstration program outlined in Section 7 has not been pursued because much of the technology associated with methane-fueled vehicles is already being demonstrated in commercial fleet operations and with advanced prototype systems. Federal support of demonstration projects would, therefore, be largely duplicative of industry programs.

DOE has reviewed the possibility of including R&D activities on methane-fueled vehicles as part of its Alternative Fuels Utilization Program (AFUP) within VERD. The goal of the AFUP is to investigate and advance the technology base associated with the end use of alternative transportation fuels. Of the $5.4 million AFUP budget request for FY82, we plan to allocate $510,000 for methane R&D. The program plan is being formulated. The study initiated in January 1981 identified several technical areas where additional work would be advantageous and is the basis for the program planning activity. To a large extent, these areas are already under investigation by private industry. With consideration of the Act's provision that the R&D program supplement rather than supplant, duplicate, displace, or lessen the R&D efforts of the private sector, the VERD program will be designed to supplement industry in its R&D endeavors.

As is reported in Appendix B, there is substantial activity in the private sector to investigate and promote the use of methane as an automotive fuel. These activities include not only the commercial sale of vehicle conversion and refueling hardware for both compressed natural gas (CNG) and liquefied natural gas (LNG), but development of advanced prototype systems. A notable example of the latt[illegible] the program underway at Ford Motor Company. Ford's R&D efforts are concentrating on improved fuel storage systems, such as lightweight composite tanks, and optimization of the basic engine by designing specifically for CNG or LNG. Two prototype vehicles, a Ford Escort and a Mercury Zephyr, have been developed to operate on CNG. In addition, a prototype Mercury Zephyr has been developed for LNG based on fuel system technology used by Beech Aircraft Corporation. All three vehicles use high-compression-ratio engines and represent dedicated "single-fuel" concepts as opposed to commercial CNG conversion systems which are largely "dual-fuel" (natural gas or gasoline) systems.

In addition to technology development, there are recent activities in the area of regulation and standards affecting methane fuel use. The Environmental Protection Agency has issued a Notice of Intent to develop modifications of its emissions standards to exempt methane as a regulated hydrocarbon since it is photochemically nonreactive and does not participate in atmospheric reactions to form smog, 46 Fed. Reg. 21628, 21629 (April 13, 1981). For methane-fueled vehicles, emission of methane can be substantial whereas non-methane hydrocarbon emissions are generally low. The proposed exemption would allow greater flexibility in the design of methane-fueled vehicles.

In the private sector, the American Gas Association has formed a task force to investigate the development of national standards for the manufacture and installation of CNG conversion equipment and filling stations. The need for such standards was identified as part of the DOE-sponsored assessment and represents an important step in the development of methane as an alternative transportation fuel. The establishment of these standards should enhance the safe and reliable operation of methane vehicles and add to user awareness and confidence in this alternative fuel source.

APPENDIX A

NOTICE OF PROPOSED RULEMAKING FOR METHANE TRANSPORTATION RESEARCH AND DEVELOPEMENT

federal register

Tuesday
November 10, 1981

Part III

Department of Energy

Office of Conservation and Renewable Energy

Methane Transportation Research and Development

DEPARTMENT OF ENERGY

Office of Conservation and Renewable Energy

10 CFR Part 478

[Docket No. CAS-RM-81-204]

Methane Transportation Research and Development; Proposed Regulations for Review and Certification of Contracts, Grants, Cooperative Agreements, and Projects

AGENCY: Office of Conservation and Renewable Energy, DOE.

ACTION: Notice of proposed rulemaking.

SUMMARY: The Department of Energy ("DOE") hereby issues a notice of proposed rulemaking to implement section 4(d) of the Methane Transportation Research, Development, and Demonstration Act of 1980. This new Act confers authority on the Secretary of Energy to expend Federal funds in order to undertake research and development activities and conduct demonstrations and technologies for methane-powered vehicles and related facilities used in fleet and farm applications. Today's notice proposes administrative regulations, as required by the Act, that establish procedures for ensuring that new contracts, grants, cooperative agreements, DOE projects, or other agency projects to be funded under the Act, supplement rather than supplant, duplicate, displace, or lessen research and development activities in the private sector. This notice solicits comments on the proposed rule and provides for a public hearing. Were it not for the legal requirement to promulgate these regulations, DOE would not do so because the Administration, as part of its policy of budgetary restraint, has proposed to Congress to prohibit DOE from expending any funds to carry out the Act.

DATES: Written comments must be received on or before January 11, 1982.

Public hearing: 9:30 a.m., December 4, 1981. Requests to speak must be received by 4:30 p.m., e.s.t., November 20, 1981. DOE will notify by November 25, 1981, persons selected to speak. Persons selected should bring 15 copies of their hearing statements to the hearing location.

ADDRESSES: Written comments and requests to speak should be addressed to: Department of Energy, Hearing and Dockets, Mail Stop 6B-025, Room 1F-085, 1000 Independence Avenue, SW., Washington, D.C. 20585 (Attn. Docket CAS-RM-81-204). Telephone (202) 252-9319.

Public hearing location: Forrestal Building, Room GJ-015, 1000 Independence Avenue, SW., Washington, D.C.

FOR FURTHER INFORMATION CONTACT:

Ralph D. Fleming, Office of Conservation and Renewable Energy, Department of Energy, 1000 Independence Avenue, SW., Washington, D.C. 20585, (202) 252-8055

Jo Ann Scott, Office of the General Counsel, Department of Energy, 1000 Independence Avenue, SW., Washington, D.C. 20585, (202) 252-9518

Hearings and Dockets (Hearing Procedures), Office of Conservation and Renewable Energy, Department of Energy, 1000 Independence Avenue, SW., Room 1F-085, Washington, D.C. 20585, (202) 252-9319

SUPPLEMENTARY INFORMATION:

I. Introduction
  A. General
  B. Statutory Background
II. Development of Proposed Regulations
III. Discussion of Proposed Regulations
  A. General Operation of Proposed Program
  B. Specific Provisions of Proposed Regulations
  C. Information to Be Considered in Review and Certification Decisions
  D. Review Under the Regulatory Flexibility Act of 1980
  E. Review Under Executive Order 12291 and OMB Circular A-116
  F. Review Under the Paperwork Reduction Act of 1980
IV. Environmental Considerations
V. Federal Grant and Cooperative Agreement Act of 1977
VI. Period for Public Comment
VII. Comment and Public Hearing Procedures
  A. Written Comments
  B. Hearing Procedures
  C. Conduct of Hearings

I. Introduction

A. General

DOE today gives notice of proposed regulations setting forth procedures, standards, and criteria for review and certification of new contracts, grants, cooperative agreements, DOE projects, and other agency projects under its Methane Transportation Research and Development Program. Section 4(d) of the Methane Transportation Research, Development, and Demonstration Act of 1980 ("ACT" or "Methane Act"), Pub. L. 96-512, 94 Stat. 2827, requires promulgation of these regulations. The objective of this review and certification program is to ensure that Federal funds to expended under the Act do not support efforts on research and development ("R&D") of methane-fueled vehicles and related facilities that supplant, duplicate, displace, or lessen the same efforts occurring or that have occurred in the private sector. These regulations, when final, will apply to any R&D contracts, grants, cooperative agreements, DOE projects, and other agency projects to be funded under the Act, including activities conducted by employees of Federal agencies.

The Administration is not seeking funds for implementation of the Methane Act. In proposed budget amendments for FY 1982 (H.D. 97-29), language has been proposed for incorporation into DOE's FY 1982 appropriation that would preclude the expenditure of such funds to implement the Act. Despite this action, the present statutory requirements, that DOE promulgate the administrative regulations under section 4(d), stand until Congress provides otherwise.

B. Statutory Background

The purpose of the Act is to establish a program within DOE involving simultaneous R&D activities and demonstrations of technologies for vehicles operating on methane as well as for related supportive facilities. The Act and the regulations proposed today define "methane" as either natural gas as defined in section 2(1) of the Natural Gas Policy Act of 1978), gas derived from coal, liquefied natural gas, or any gaseous transportation fuel produced from biomass, waste products, and other renewable resources. The program provides for advanced and accelerated research into methane vehicle design, methane distribution systems, and storage facilities. It is also intended to demonstrate the economic and technological practicalities of methane-fueled vehicles for fleet use and on-farm operations.

The statutory provisions governing the requirements and applicability of the review and certification program are the six subsections of section 4(d) and the provisions of section 5(a).

Section (d)(1) of section 4 sets forth the substantive policies to be followed by DOE in the exercise of its overall management responsibility for conducting the program. The subsection requires DOE to conduct the program so as to supplement private industry R&D efforts, and avoid supplanting, duplicating, displacing, or lessening those efforts.

Section (d)(2) requires DOE to issue the administrative regulations, which are published in proposed form today. Procedures, standards, criteria, and certification requirements are the specified content of these regulations. The subsection calls for discussion in the certification of the relationship of any related or comparable industry R&D to the R&D proposed to be conducted under the Act, as well as related issues such as cost sharing and patent rights. Section (d)(3) requires that the certifications be available to the House Committee on Science and Technology and the Senate Committee on Energy and Natural Resources. In addition, the subsection makes certifications subject to public disclosure under the Freedom of Information Act and the Federal Nonnuclear Energy Research and Development act of 1974, as amended. However, the subsection does not permit judicial review of any certifications and otherwise exempts them from coverage by the Administrative Procedures Act.

Sections (d)(4) and (d)(5) require that a discussion similar to that contained in the certifications be included in annual reports and budget submissions under the Act.

Section (d)(6) limits the scope of section 4(d) to new contracts, grants, cooperative agreements, DOE projects, or other agency projects. It excludes from coverage the contracts, grants, cooperative agreements, DOE projects, or other agency projects formally initiated prior to enactment, as well as any renewal or extension thereof.

Section 5 directs the Secretary to coordinate the functions of this program with related regulatory activities and other responsibilities of DOE and other Federal departments or agencies, and directs other entities within the Federal executive branch to carefully consider any written request for assistance from the Secretary.

II. Development of Proposed Regulations

The proposed regulations would ensure that R&D supported under the Act will not supplant, duplicate, displace, or lessen similar efforts occurring in the private sector. The procedures established in these regulations are intended to make certain that DOE program officials are fully cognizant of related R&D being carried out under private auspices. In particular, the requirement of an annual review of industry programs and the requirement that a DOE program plan be prepared annually and reviewed by the private sector and other Federal agencies provide an explict vehicle for identifying possible areas of duplication prior to the commitment of DOE funds. Other Federal agencies which may comment include, but are not limited to, the Department of Transportation ("DOT"), Department of Agriculture ("USDA"), Environmental Protection Agency ("EPA"), National Aeronautics and Space Administration ("NASA"), Department of Defense ("DOD"), Department of Commerce ("DOC"), and National Science Foundation ("NSF").

The process is intended to be flexible to enable DOE officials to be well informed about current R&D in the area of methane transportation. They then will be able to accurately exercise professional judgment in the course of determining certification as required by the Act. Such certification may be carried out concurrently with technical review of applications for R&D support in order that applicants may receive prompt and complete decisions from DOE on the disposition of their proposals.

The proposed regulations differ from the approach taken by DOE in implementing similar requirements with respect to automotive propulsion under Pub. L. 95-238. While that approach was cited favorably by the report of the Senate Committee on Energy and Natural Resources (S. Rept. 96-1006), the approach proposed today is preferable since it reduces the burden on the public. It does so by providing for critique of overall program plans prior to program execution rather than soliciting comments on a project-by-project basis. Further, the proposed approach places responsibility for knowledge of private sector activities squarely upon the Federal program manager rather than relying upon the private sector to object to individual projects on a case-by-case basis. It is believed that the regulations proposed will more fully permit DOE to carry out the Act than would the approach used to implement Pub. L. 95-238, because it will require the appropriate Federal officials to have public comments in the context of the entire methane transportation R&D program.

III. Discussion of Proposed Regulations

A. General Operation of Proposed Program

R&D projects can be conducted under a variety of arrangements, and although not all of these arrangements may be used, the regulations proposed today are designed to anticipate all the possibilities. Under the Act, the possible arrangements are R&D—

1. By employees of DOE or national laboratories operated by DOE (DOE project);
2. By employees of other Federal agencies or national laboratories operated by other Federal agencies (agency project);
3. Under an unsolicited or solicited contract, grant, or cooperative agreement entered into by DOE with a person, private organization, or non-Federal public agency; and
4. Under an unsolicited or solicited contract, grant, or cooperative agreement entered into by a Federal agency other than DOE (such as NASA) with a person, private organization, or non-Federal public agency pursuant to an interagency agreement with DOE.

The major features of the proposed regulations are:

1. Development and compilation of information for use by DOE and other program managers, identifying industry R&D relevant to the Act;
2. Reviewing requested comment on DOE program plans by industry and other Federal agencies;
3. Standards and criteria to prevent duplication, displacement or lessening of private industry R&D;
4. Review and certification of proposed projects by program managers with the assistance of appropriate technical experts.

In the event that a manager is dealing with an application or proposal for a new contract, grant, or cooperative agreement, the proposed regulations call for completion of the review process prior to actual negotiation of the agreement with the result to be promptly reported to the applicant. The certification document will be prepared by the manager in advance of such a negotiation, but not formally signed until the negotiations are completed. In this way, no applicant for a contract, grant, or cooperative agreement will have to negotiate with uncertainty as to the outcome of the review process under the regulations.

DOE emphasizes that the procedures and requirements proposed today as 10 CFR Part 478 are in addition to, rather than in substitution for, the general contract, grant, and cooperative agreement procedures and requirements of whichever Federal agency funds the research (in the case of DOE, 10 CFR Part 600 for grants and cooperative agreements and the Federal procurement regulations as modified by 41 CFR Chapter 9 for contracts). Certification under 10 CFR Part 478 does not constitute the award of the contract, grant, or cooperative agreement, but certification is necessary before an award can be made.

B. Specific Provisions of Proposed Regulations

1. *Development of Information Describing Industry R&D.* Under § 478.3, today's proposal would ensure that no contract, grant, cooperative agreement, DOE project, or agency project be

certified without the program manager having undertaken systematically to determine its relationship to ongoing industry activities relevant to the Act. This determination will be based on current information concerning industry R&D activities for methane-powered vehicles and related facilities. This information can be developed through analysis of current technical literature, through searching subject data archives such as the National Technical Information Center or the Smithsonian Science Information Exchange, and through contacts with private sector organizations performing related R&D. A formal mandatory survey using a standardized survey instrument is not proposed due to the burden it would place on respondents and the problems of designing categories to avoid problems with proprietary data or information. Assembly of such information annually is intended to provide the funding agency with a background needed to make informed professional judgments. The information, including the sources and contacts, will be complied by the program manager, and excluding any proprietary information, will be available to the public.

2. *Comments on DOE Program Plan.* In accordance with sound R&D management principles, DOE must necessarily complete a written plan for program execution before committing public funds each fiscal year. As part of the process of ensuring that planned program commitments will not supplant, duplicate, displace or lessen private-sector efforts, this plan will be subject to review and comment by experts in public and private organizations. The program manager will request comments from other Federal agencies, such as DOT, EPA, NASA, USDA, DOD, DOC, and NSF, which have an interest in the outcome of the R&D or which have potentially duplicating activities. To carry out the purposes of the Act, the reviewers will be asked to comment on the appropriateness of Federal versus private sector support for the R&D projects as well as on the technical substance of the program plan. A notice of the availability of the program plan for comment will be placed in the *Commerce Business Daily* and the Federal Register in order to assure that the opportunity exists for all interested parties to comment. The program manager will keep a record of those notices and of the comments received and of their disposition, and this record will be available to the public; however, final responsibility for the content of the DOE program plan must rest with the judgment of the DOE program manager.

3. *Standards and Criteria.* The standards and criteria in § 478.8 are the basis for determining whether a contract, grant, cooperative agreement, DOE project, or other agency project is certifiable under the Act. As noted above, they are in addition to the normal requirements of DOE or other Federal agencies for the award of contracts, grants, or projects.

The proposed § 478.8 states six related standards and criteria in general terms. If adopted, these standards and criteria would permit certification only upon findings that the R&D to be performed—

1. Supplements private R&D on methane-fueled vehicles and related facilities;
2. Is not duplicative of previously abandoned R&D without good cause;
3. Would not be performed during the term of the award without Federal funding;
4. Results in an accelerated target date for commercialization;
5. Is not duplicative of successful past and current private R&D; and
6. Does not constitute a Federal subsidy of existing efforts but rather accelerates R&D efforts by an applicant for a contract, grant, or cooperative agreement.

These standards and criteria are based on the language of the Act and DOE experience in setting standards and criteria for the automotive propulsion program under the DOE Act of 1978.

4. *Review by Manager.* The proposed regulations define the term "manager" to mean the program official who requests that a contracting officer negotiate a contract, grant, or cooperative agreement; who authorizes the start of a DOE project as defined in § 478.2; or who requests that a contracting officer authorize transfer of DOE funds for an agency project as defined in § 478.2. DOE and agency projects are conducted only by full-time Federal employees or employees of Federal national laboratories. In some instances, the manager will be an employee of DOE, in others, an employee of another agency, such as DOT or NASA. The manager should not be the employee responsible for formal negotiation of a grant, contract, or cooperative agreement.

The timing of the review differs depending upon the arrangement under which the proposed R&D is to take place. For unsolicited proposals for contracts, grants, or cooperative agreements, the manager will be reacting to a proposal from outside the Federal Government. In the case of solicitations for contracts, grants, or cooperative agreements, the manager will be reviewing the solicitation prior to its release, and the manager will also be responsible for reviewing incoming proposals at a later stage of the certification process.

5. *Information Required from Applicant.* Apart from the general information resources, which will bring about informed decisionmaking under the review and certification system proposed today, the proposed regulations call for project-specific information or justification from applicants for contract, grant, or cooperative agreements. This specific material will enable managers to focus on the impact a contract, grant, or cooperative agreement would have upon the R&D program of the applicant in light of the standards and criteria of § 478.8. The requirements for this material are set forth in § 478.5 of the proposed regulations and, in responding to them, the applicant will provide information necessary to apply the standards and criteria.

In some instances, § 478.5 asks questions calling for simple answers:

1. Will the R&D initiate or continue an R&D program?
2. What is the expected delay in an applicant's timetable for the development of a methane-fueled vehicle or related facility that would occur but for the grant, cooperative agreement, or contract?

In other instances, complex responses may be anticipated. For example, the proposed section would have applicants—

1. Discuss allegedly comparable industrial R&D; and
2. Justify further R&D of abandoned systems.

In casting the provisions of § 478.5, DOE has sought to minimize the burden of responding, consistent with its statutory obligations. Under this section, an applicant would have to provide a written certification to DOE that the grants, cooperative agreement, or contract funds would represent a real year-to-year increase in the expenditure of the applicant's resources. DOE has not asked for submission of detailed budget figures because it believes that the possibility of an investigation and the possible consequences of discovery are enough to warrant belief in the veracity of such assurance. DOE also wishes to minimize the burden and cost of applying for a grant, cooperative agreement, or contract.

Applicants or other persons submitting information under the regulations should bear in mind that DOE is subject to the disclosure requirements of the Freedom of Information Act and the Federal Nonnuclear Energy Research and Development Act of 1974.

6. *Certification.* Based on a consideration of all relevant information, including the DOE program plans and comments thereon, data from appropriate Federal agency and private sector sources compiled annually under § 473.3, as well as information submitted by the applicant, the manager decides whether to certify the proposed R&D project. Examples of private sector sources are: international symposia; foreign and domestic fleet operations using methane fuel; professional and manufacturing organizations such as the Society of Automotive Engineers, the American Society of Mechanical Engineers, the American Gas Association, and the Motor Vehicle Manufacturers Association; and semiannual Contractor Coordination Meetings at which DOE staff and contractors report on the status of advances in automotive technology. If the manager is not an employee of DOE, the proposed regulations require DOE concurrence in the certification decision. DOE concurrence stems from its overall management responsibility stipulated in the Act. Negative decisions are to be communicated in writing to applicants in the case of contracts, grants, or cooperative agreements. Affirmative decisions will lead to preparation of a certification of the contract, grant, cooperative agreement, DOE project, or other agency project, with distribution of copies to the applicant and DOE program manager, as appropriate.

Reflecting the provisions of section 4(d) of the Act, the proposed regulations require the manager to include in the certification a discussion of the contract, grant, cooperative agreement, or agency project R&D to be performed, showing compliance with the applicable standards and criteria and any arguably comparable private R&D. Also reflecting statutory demands, the proposed regulations require that the certification deal with cost sharing and patent rights, where relevant, in the case of grants, cooperative agreements, or contracts. The information on cost sharing and patent rights will also be incorporated in the actual award.

The proposed regulations also contain § 478.5, describing the extent to which certifications are subject to review or disclosure. The provisions of that section are drawn from the statute and are included for the convenience of readers of the Code of Federal Regulations.

C. Review Under the Regulatory Flexibility Act of 1980

These proposed regulations were reviewed under the Regulatory Flexibility Act of 1980, Pub. L. 96-354 Stat. 1164, which requires preparation of a regulatory flexibility analysis for any regulation that will have a significant economic impact on a substantial number of small entities. DOE has concluded that a regulatory flexibility analysis is not necessary because the main function of these regulations is to define the procedures which DOE itself will follow. The chief effects of these regulations on small businesses and other sections of the industry and the public will be the minor delay involved in processing proposals, and potential savings on duplicative R&D. The costs to small businesses and other sections of the public for compliance with these regulations will be comparatively small and limited to the costs of providing information in an application for a grant, cooperative agreement, or contract.

Furthermore, only new contracts, grants, cooperative agreements, and projects will come under the regulations. The Act and regulations specify that the renewals and extensions of existing contracts, grants, cooperative agreements, or projects are not subject to the review and certification program.

For all the above reasons, this hereby certifies that 10 CFR Part 478 will not have a significant economic impact on a substantial number of small entities.

D. Review Under Executive Order 12291 and OMB Circular A-116

These regulations were also reviewed under Executive Order 12291 (46 FR 13193, February 19, 1981), implementing DOE directives thereunder, and Office of Management and Budget ("OMB") Circular A-116. These regulations are not "major" according to the terms of the Executive Order, for the reasons stated in discussion of the Regulatory Flexibility Act. That is, they do not result in an annual effect on the economy of $100 million or more; a major increase in costs for consumers, industries, or government; or significant adverse effects on competition, employment, investment, productivity, innovation, or the ability of domestic businesses to compete with foreign enterprises. These regulations will not have an impact which is truly major in terms of gross economic and social effects or of promoting achievement of national energy conservation goals. Therefore, they do not require analysis under Executive Order 12291 or an urban community impact analysis under OMB Circular A-116.

E. Review Under the Paperwork Reduction Act of 1980

A copy of these regulations has been submitted to the Director of OMB for review under the Paperwork Reduction Act of 1980 (Pub. L. 95-511). DOE recognizes that OMB approval is necessary under section 3507 of Pub. L. 96-511 in order to request the applicant information required under § 478.5 of this notice. However, DOE is not yet requesting OMB approval because the Administration is not seeking funds to implement the Methane Act. Should funds be appropriated for the methane R&D program, OMB approval will be obtained prior to any information gathering under § 478.5 of this notice.

IV. Environmental Considerations

DOE has concluded that promulgation of these regulations does not require preparation of an environmental assessment or of an environmental impact statement under the National Environmental Policy Act ("NEPA") of 1969 (42 U.S.C. 4321, et. seq. (1970)), the Council on Environmental Quality Regulations (40 CFR Parts 1500-1508), and the DOE guidelines (45 FR 20694, March 28, 1980). The regulations are procedural in nature and their issuance will not result in a predictable significant environmental impact. DOE is, however, committed to ensuring that individual contracts, cooperative agreements, grants, or projects executed by DOE will comply with applicable requirements of NEPA.

V. Federal Grant and Cooperative Agreement Act of 1977

The Federal Grant and Cooperative Agreement Act of 1977 (41 U.S.C. 501-509 (1970)) requires that the appropriate assistance instrument (grant or cooperative agreement) or procurement contract be used in Federal assistance or acquisition programs. The proposed regulations refer to cooperative agreements because DOE anticipates that there may be instances when section 6 of the Federal Grant and Cooperative Agreement Act will permit their use because of substantial involvement between DOE and the recipient.

VI. Period for Public Comment

A 60-day comment period is being provided for public review and comment on this proposed rulemaking.

VII. Comment and Public Hearing Procedures

A. Written Comments

Interested persons are invited to participate in this rulemaking by submitting data, views, or arguments with respect to today's proposed procedures, standards, and criteria. Comments should be submitted to the address indicated in the addresses section of this preamble. Comments should be identified on the outside of the envelope and on documents submitted to DOE with the designation—Methane Transportation R&D—Proposed Rule (Docket No. CAS-RM-81-204). Ten copies should be submitted. All comments received before 4:30 p.m., e.s.t. on (date TBD) and all other relevant information will be considered by DOE before final action is taken on the proposed regulations. All comments received will be available for public inspection in the DOE Reading Room, Room 1E-190, Forrestal Building, 1000 Independence Avenue, S.W., Washington, D.C. 20585, between 8:00 a.m. and 4:00 p.m., Monday through Friday.

Pursuant to the provisions of 10 CFR 1004.11, any person submitting information which he or she believes to be confidential and exempt by law from public disclosure should submit one complete copy, appropriately labeled for limited disclosure, and ten copies from which information claimed to be confidential has been deleted. In accordance with the procedures established in 10 CFR 1004.11, DOE will make its own determination with regard to any claim that information submitted be exempt from public disclosure.

B. Hearing Procedures

The time and place of the public hearing are indicated in the dates and addresses section of this preamble. DOE invites any person who has an interest in the proposed rulemaking issued today, or who is a representative of a group or class of persons that has an interest in today's proposed rulemaking, to make a written request for an opportunity to make an oral presentation. Such a request should be directed to the address indicated in the addresses section of this preamble, must be received before 4:30 p.m. e.s.t. on November 20, 1981, and may be hand delivered to such address, between the hours of 9 a.m. and 5 p.m. e.s.t., Monday through Friday. A request should be labeled both on the document and on the envelope—Methane Transportation R&D—Proposed Rule (Docket No. CAS-RM-81-204).

The person making the request should briefly describe the interest concerned, state why she or he is a proper representative of a group or class of persons that has such an interest, if appropriate, and give a concise summary of the proposed oral presentation and a telephone number where she or he may be contacted during the day before the hearing.

DOE will notify, before 4:30 p.m. e.s.t., November 25, 1981, each person selected to appear at the hearing. Each person selected to be heard should bring 15 copies of her or his statement to the hearing location.

C. Conduct of Hearings

DOE reserves the right to select the persons to be heard at the hearing, to schedule their respective presentations, and to establish the procedures governing the conduct of the hearing. The length of each presentation may be limited, based on the number of persons requesting to be heard.

A DOE official will be designated to preside at the hearing. This will not be a judicial or evidentiary-type hearing. Questions may be asked only by those conducting the hearing and there will be no cross-examination of the persons presenting statements. Any decision made by DOE with respect to the subject matter of the hearing will be based on all information available to DOE. At the conclusion of all initial oral statements, each person who has made an oral statement will be given the opportunity, if she or he so desires, to make a rebuttal statement. The rebuttal statements will be given in the order in which the initial statements were made and will be subject to time limitations.

Any interested person may submit questions to be asked of any person making a statement at the hearing to the registration desk. DOE will determine whether the question is relevant and whether the time limitations permit it to be presented for answer.

Any further procedural rules needed for the proper conduct of the hearing will be announced by the presiding officer.

A transcript of the hearing will be made and the entire record of the hearing, including the transcript, will be retained by DOE and made available for inspection at the DOE Freedom of Information Reading Room, Room 1E-190, Forrestal Building, 1000 Independence Avenue, S.W., Washington, D.C. 20585, between the hours of 8 a.m. and 4 p.m., Monday through Friday. Any person may purchase a copy of the transcript from the reporter.

In consideration of the foregoing, DOE hereby proposes to amend Chapter X of title 10, Code of Federal Regulations, by establishing Part 478 as set forth below:

Issued in Washington, D.C., October 20, 1981.

Joseph J. Tribble,

Assistant Secretary, Conservation and Renewable Energy.

10 CFR is amended by adding a new Part 478, reading as follows:

PART 478—METHANE TRANSPORTATION RESEARCH AND DEVELOPMENT; REVIEW AND CERTIFICATION OF CONTRACTS, GRANTS, COOPERATIVE AGREEMENTS, AND PROJECTS

Sec.

478.1 Purpose and scope.
478.2 Definitions.
478.3 Development of information on industry research and development.
478.4 Review of DOE program plans.
478.5 Required information from applicant.
478.6 Review and certification by manager.
478.7 Disclosure and reviewability of certification.
478.8 Standards and criteria.

Authority: Methane Transportation Research, Development, and Demonstration Act of 1980, Pub. L. 96-512, 94 Stat. 2827 (15 U.S.C. 3801); Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565 (42 U.S.C. 7101 note).

§ 478.1 Purpose and scope.

These regulations implement section 4(d) of the Methane Transportation Research, Development, and Demonstration Act of 1980 (15 U.S.C. 3801), and apply to each new contract, grant, cooperative agreement, Department of Energy (DOE) project, or other agency project funded or to be funded under the research and development authority conveyed upon the Secretary of Energy by that Act. These regulations do not apply to subcontractors, contractors under grants or cooperative agreements, or to contracts, grants, cooperative agreements, DOE projects, or other agency projects entered into, made, or formally approved and initiated prior to December 12, 1980, or with respect to any renewal or extension thereof. Insofar as contracts, grants, and cooperative agreements are concerned, these regulations provide procedures and requirements, in addition to those generally applicable under the assistance and procurement regulations of the Federal agency funding the research and development under the Act.

§ 478.2 Definitions.

For purpose of these regulations—

"Act" means the Methane Transportation Research, Development, and Demonstration Act of 1980, Pub. L. 96–512, 94 Stat. 2827 (15 U.S.C. 3801).

"Agency project" means research and development requested by DOE under the Act performed by employees of a Federal agency or of a national laboratory operated for a Federal agency.

"Applicant" means any private laboratory, university, nonprofit organization, industrial organization, private agency, institution, organization, corporation, partnership, individual, or public agency other than a Federal agency.

"DOE" means the United States Department of Energy.

"DOE project" means research and development under the Act by employees of DOE or of a national laboratory operated for DOE.

"Federal agency" means an executive agency as defined by 5 U.S.C. 105.

"Manager" means the Federal program official who requests that a contracting or grants officer negotiate a contract, grant, or cooperative agreement; who requests that a contracting officer authorize transfer of DOE funds for an agency project; or who authorizes a DOE project to begin.

"Methane" means either natural gas (as defined in section 2(1) of the Natural Gas Policy Act of 1978), gas derived from coal, liquefied natural gas, or any gaseous transportation fuel produced from biomass, waste products, and other renewable resources.

"Related facilities" means any facility for the transmission, storage, or dispensing of methane fuel for vehicles.

"Research and development" means activities constituting a project to advance the state of the art of methane-fueled vehicles or related facilities and does not mean activities involving technology transfer to mass production, evaluative testing, preliminary planning for a DOE or an agency project, or program administration and management.

"Solicitation" means a formal, written request for proposals/applications to perform research and development under a contract, grant, or cooperative agreement, typically including evaluation criteria and a statement of the work to be done or areas to be investigated.

"Vehicle" means any truck, van, station wagon, bus, or car used on public roads or highways as well as off-road agricultural equipment, such as tractors, harvesters, and so forth, which currently burn gasoline or diesel fuel.

§ 478.3 Development of information on industry research and development.

Before completing program planning for each fiscal year, the manager shall search appropriate data archives to identify planned, ongoing, or completed research and development on methane-fueled vehicles and related facilities. In addition, when necessary the manager shall contact private sector entities to determine the nature of any research and development of this kind which they may be planning or conducting. This information, which will provide a data base for making certifications under § 478.6, shall be compiled and made available to the public, after removal of any proprietary information as described in 10 CFR § 1004.10(b)(4).

§ 478.4 Review of DOE program plans.

In formulating a program plan for the program authorized by the Act, the DOE manager shall make the draft program plan available for review and shall solicit comments from persons, in both the private sector and other Federal agencies, concerned with research and development of methane-powered vehicles and related facilities. At the same time, the manager shall place in the *Commerce Business Daily* and the Federal Register notices that the plan is available for comment. The manager shall take these comments into account in ensuring that planned projects will not supplant, duplicate, displace, or lessen private sector activities as provided in the Act. The manager shall maintain and make available a record of the comments solicited and received, and shall include in the paragraph plan a discussion of the consideration of the comments.

§ 478.5 Required information from applicant.

Any proposal for a contract, grant, or cooperative agreement, under the Act to support research and development activities of methane-fueled vehicles or related facilities must—

(a) State whether the activities will initiate or continue research and development of methane-fueled vehicles or related facilities;

(b) State, insofar as the applicant has information, whether and to what extent the activities to be supported are technically the same as activities conducted previously or to be conducted during the term of the award by any person for research and development of a substantially similar methane-fueled vehicle or related facility;

(c) Justify research and development activities on methane-fueled vehicles or related facilities abandoned by any person because of a lack of mass production potential by presenting information showing a significant intervening technological advance, promising conceptual innovation, or other special consideration;

(d) Provide an assurance that the amount of the applicant's own funds to be expended for research and development of methane-fueled vehicles or related facilities will not be diminished as a result of the award of a contract, grant, or cooperative agreement.

(e) Provide to the extent possible—

(1) An assurance that the time period for completing research and development of the methane-fueled vehicles or related facilities is likely to be shorter as a result of a contract, grant, or cooperative agreement; and

(2) The estimated delay, if any, which is likely to occur if the application for a contract, grant, or cooperative agreement is denied.

Information required from the applicant shall also be set forth in the solicitation notice for a contract, grant, or cooperative agreement.

§ 478.6 Review and certification by manager.

(a) The manager shall reject any proposal that has not been completed in accordance with § 478.5 of these regulations or any other generally applicable requirements for the submission of proposals. A rejected proposal may be corrected, amended or resubmitted as permitted by the applicable procedures under the assistance and procurement regulations of the Federal agency receiving the proposal.

(b) After the preliminary review and prior to recommending that contracting officials negotiate an award, the manager shall review the proposed research and development to be performed under contract, grant, or cooperative agreement, to determine whether the proposed project meets the standards and criteria of § 478.8.

(c) Upon consideration of all relevant information, including the DOE program plan, any applicable comments on the program plan, information on private-sector research and development programs compiled annually under § 478.3, and all material submitted by the applicant, the manager—

(1) Shall determine whether the research and development to be performed complies with the standards and criteria of § 478.8;

(2) Shall obtain the concurrence of DOE on the certification decision, either affirmative or negative, if the manager is not an employee of DOE;

(3) Shall, in the event of a negative determination under this section, advise the applicant of the decision in writing with a brief statement of supporting reasons; and

(4) Shall, in the event of an affirmative determination under this section, prepare a certification—

(i) Explaining the determination;

(ii) Discussing any allegedly related or comparable industrial research and development considered and not deemed to be an adequate basis for not certifying the contract, grant or cooperative agreement;

(iii) Discussing issues regarding cost sharing and patent rights related to the standards and criteria of § 478.8 of these regulations; and

(iv) Discussing any other relevant issue.

(d) After complying with paragraph (c) of this section, the manager shall sign the certification and distribute copies to the applicant, if any, and to DOE, if the manager is not a DOE employee—

(1) Immediately in the case of a DOE or agency project; and

(2) After the agreement has been negotiated in the case of a contract, grant, or cooperative agreement. The applicant's copy shall accompany the award. In this case, the manager shall informally notify the applicant of the outcome of his decision under paragraph (c)(1) of this section as soon as possible after it is made.

§ 478.7 Disclosure and reviewability of certification.

Any certification issued under these rules is—

(a) Subject to disclosure under 5 U.S.C. 552 and section 17 of the Federal Nonnuclear Energy Research and Development Act of 1974, as amended, 42 U.S.C. 5918; and

(b) Available to the Committee on Science and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate; and

(c) Subject neither to judicial review nor to the provisions of 5 U.S.C. 551–559, except as provided under paragraph (a) of this section.

§ 478.8 Standards and criteria.

Research and development to be performed under a contract, grant, or cooperative agreement, as a DOE project, or as an agency project under the Act may be certified under these regulations only if the research and development to be conducted—

(a) Supplements the research and development efforts of industry or any other researcher on methane-fueled vehicles or related facilities;

(b) Is not duplicative of efforts previously abandoned by private researchers unless the project has been justified by an intervening technological advance, promising conceptual innovation, or other special consideration;

(c) Would not be performed during the term of the award but for the availability of the Federal funding being sought;

(d) Is likely to produce an advanced methane-fueled vehicle or related facility suitable for steps toward technology transfer to mass production in a shorter time period than would otherwise occur;

(e) Is not technologically the same as efforts, by any person, conducted previously or to be conducted during the term of the award regarding a substantially similar advanced methane-fueled vehicle or related facility; and

(f) Is not likely to result in a decrease in the level of private resources expanded for research and development on methane-fueled vehicles and related facilities by substituting Federal funds without justification.

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APPENDIX B

STATE-OF-THE-ART ASSESSMENT OF
METHANE-FUELED VEHICLES

DECEMBER 1981

U.S. DEPARTMENT OF ENERGY
ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLE ENERGY
OFFICE OF VEHICLE AND ENGINE R&D

STATE-OF-THE-ART ASSESSMENT OF METHANE-FUELED VEHICLES

1. INTRODUCTION

The Methane Transportation Research, Development, and Demonstration Act of 1980 (PL 96-512) focused on the expanded use of methane as a fuel for fleet-operated vehicles. In formulating the Act, Congress found that:

- Methane use in fleet-operated vehicles would result in a substantial reduction in oil imports with the potential for concurrently reducing vehicle emissions.
- Methane, now found principally in natural gas, is presently underutilized in the United States. Alternative sources for increased quantities of methane in the future include coal, biomass, waste products and other renewable resources.

Implementation of the Act is the responsibility of the Department of Energy's (DOE's) Office of Vehicle and Engine R&D. Section 7 (a) of the Act requires DOE to assess the current state-of-the-art of methane-fueled vehicles by 1 January 1982 to develop baseline data for evaluating potential improvements in applicable vehicle technologies. This report is intended to fulfill this requirement.

Following the definitions provided in the Act, the term "methane" as used in this report includes, and is interchangeable with, natural gas as well as gas derived from coal, biomass, waste products or other renewable resources, provided methane is the predominant constituent. Methane is considered to have application as a vehicle fuel in the form of either compressed natural gas (CNG) or liquefied natural gas (LNG). Finally, the Act defines the term "vehicle" to mean any truck, bus, car, station wagon or van operated on public roads or highways, as well as off-road agricultural vehicles.

This assessment is based primarily on data from a study conducted by The Aerospace Corporation for DOE's Office of Vehicle and Engine R&D. The final report on this study, which documents study findings, will be submitted to DOE by February 10, 1981.*

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* The report will be available in DOE's Freedom of Information Reading Room (Room 1E-090, Forrestal Building, 1000 Independence Avenue, SW, Washington, D.C.).

2. ADVANTAGES AND DISADVANTAGES OF METHANE FUEL

Methane, in the form of natural gas, has been utilized as a vehicle fuel for many years in Europe but it did not generate significant interest in the United States until the late 1960s. At that time, the impetus for the introduction of methane-fueled vehicles was the alleviation of air pollution through reduced exhaust emissions. Later, tight gasoline supplies during the Arab Oil Embargo of 1973, soaring costs of gasoline in the late 1970s, and increased availability of natural gas in current markets have fostered increased interest in methane as an alternative to gasoline.

2.1 ADVANTAGES

Methane possesses many favorable attributes as a vehicle fuel. It is particularly suitable for spark ignition (SI) engines, which can be converted by adding a methane storage and feed system to permit operation on either gasoline or methane.

On an equal energy basis, CNG and LNG are currently priced significantly lower than gasoline with the probability that they will continue to maintain an appreciable cost advantage for the user. Methane's principal feature as a fuel for SI engines is its high research octane number (RON) of 130, which permits the use of high compression ratio engines in vehicles designed specifically for methane, with accompanying efficiency benefits. In addition, the broad flammability limits of methane allow efficient engine operation with lean air-fuel mixtures, and the gaseous state of the fuel reduces engine pumping losses by decreasing the degree of throttling required for a given power setting. With regard to exhaust emissions, the simple chemistry of methane is beneficial, leading to low engine deposits and low hydrocarbon emissions. Also, much of the hydrocarbon emissions is comprised of non-reactive methane, thus potential adverse impacts on public health and the environment are considerably lower than for conventional fuels. Furthermore, methane has thus far proved to be a safe vehicle fuel, although the data base is substantially less extensive than for petroleum fuels.

From the national standpoint, a very important advantage of methane is the potential displacement of substantial quantities of petroleum by domestically-produced gas, which enhances U.S. security and improves the country's balance-of-payments position.

2.2 DISADVANTAGES

Inasmuch as methane is a gas at atmospheric conditions, it must be stored onboard the vehicle as either a compressed gas or cryogenic (very low temperature) liquid at the present state of technology. Other storage concepts, such as adsorption on activated carbon, are under investigation by industry in an effort to reduce weight, volume, and handling problems associated with current approaches. For example, the use of a two-cylinder CNG system presently adds between 250 and 300 pounds to the weight of the vehicle and occupies a significant fraction of a car's trunk volume, while providing a range of only 60 to 120 miles. Conversely, an LNG single-fuel system weighs approximately the same as a gasoline configuration but occupies about twice the volume, while providing a range of 300 to 400 miles.

Because of methane's gaseous state, its use results in a moderate reduction in peak engine power due to air displacement in the intake system. Another unfavorable property of methane is its low flame speed which tends to decrease the thermal efficiency of spark ignition engines. However, much of this latter loss may be recovered by means of spark timing optimization. Finally, the low cetane number of methane makes it unsuitable as the sole fuel for conventional diesel engines. However, as discussed in Section 3.3, methane may be used in diesel engines in conjunction with pilot injection of diesel fuel or other techniques.

3. VEHICLE SYSTEM STATUS

Over 250,000 vehicles in Italy, more than 20,000 in the United States, and lesser numbers in other countries are currently capable of operating on methane. These vehicles have, almost exclusively, carbureted spark ignition engines, converted to operate in a dual-fuel mode on either CNG or gasoline. Conversion kits of both domestic and foreign designs are commercially available for these engines from several suppliers. CNG systems are sold by Dual Fuel Systems, Inc.; Gas Service Energy Corporation; Advanced Fuel Systems, Inc.; Essex Cryogenics, Inc.; Dual Energy Inc.; CNG Services, Inc.; CNG Fuel Systems Incorporated of Canada; and Auto Italia of Italy.

Vehicles converted to LNG are much fewer in number. At present, there is only one large utility car and light-duty truck fleet of over 100 vehicles in operation, that of the Atlanta Gas Light Company. Two currently active developers/producers of LNG conversion kits are Beech Aircraft Corporation and LNG Services, Inc. However, Essex Cryogenics, Inc., Kaiser Electro Precision, and Gibson Cryogenics have built conversion equipment in the past and might reenter the market if there were a resurgence of LNG system orders.

Vehicles designed to obtain optimal efficiency from methane fuel are in the development and demonstration stage at this time. Because of the significant engine design changes required, e.g., compression ratios of 12 to 14 and basic spark advance of about 20 degrees before top center (BTC), satisfactory operation on the relatively low octane gasoline currently marketed by domestic refiners is not possible. Single fuel CNG and LNG vehicles have recently been built, but only limited performance data are available. A major problem in the use of CNG is the achievement of adequate vehicle range without incurring excessive storage weight and volume penalties.

Conversion of compression ignition (CI) engines to methane operation is difficult because of the very low cetane number of the gas. Only experimental vehicles have been operated to date and no conversion kits are commercially available.

Currently, the cost of new CNG or LNG conversion systems is in the range of $1200 to $2000 per vehicle. In addition, since there is no publicly-available supply system in place at this time for either CNG or LNG, each user must provide his own fueling facilities. For this reason, implementation of methane fuel is presently confined to fleet operators. In the case of CNG, complete compressor station installations are commercially available from several suppliers, adding about $1000 to $2000 to the conversion cost of each vehicle served by the station. Production of LNG requires a fairly large and sophisticated plant, typically owned by natural gas distribution companies for peak load shaving needs. For this reason, the only current, large LNG fleet is operated by the Atlanta Gas Light Company. However, it may be feasible to locate LNG fleets some distance from such peak shaving plants and transport the fuel by tank truck, rail or pipeline to a storage tank on the premises of the fleet operator.

The number of fleet vehicles that are potential candidates for methane conversion is large, and the accompanying petroleum savings would be significant. Commercial, industrial, and governmental passenger car fleets total approximately 13 million automobiles, which currently consume more than 1 million barrels of petroleum per day, approximately 95 percent of which is gasoline. At least 10 passenger vehicles may be needed in a fleet to justify the capital investment in dual-fuel CNG or LNG vehicular and fueling systems. There are approximately 4.8 million vehicles in fleets of this size, currently consuming 0.4 million barrels of petroleum fuel per day. For an estimated 90 percent natural gas usage, the petroleum savings potential is approximately 0.35 million barrels per day.

In the case of trucks, six or more vehicles may be needed in a fleet to justify the capital investment in vehicular and fueling systems. Currently, the candidate truck fleet vehicles number 4.2 million and consume about 1 million barrels of petroleum fuel per day, of which 25 percent is gasoline. For an estimated 90 percent natural gas use in spark ignition engines and maximum estimated gaseous fuel utilization in diesels, the petroleum savings potential is appproximately 0.8 million barrels per day.

3.1 CNG SYSTEMS FOR SI ENGINES

The principal type of dual-fuel conversion system for CNG marketed in the United States consists of one or more compressed gas steel storage cylinders, high-pressure tubing leading to a first stage high-pressure regulator assembly, an interstage solenoid shutoff valve, a second stage low-pressure regulator which provides gas to a gas-air mixer, a fuel pressure gauge, and a manual fuel selection device operated from the driver's seat. Fuel switching between gas and gasoline can, in most cases, be accomplished while driving. The gas cylinders are loaded to about 2400 pounds per square inch (psi) through a fill connection on the high-pressure delivery line that is located in the engine compartment.

On the basis of lower heating values for typical natural gas and gasoline, 125 standard cubic feet (scf) of gas are equivalent to one gallon of gasoline. Since a typical steel CNG cylinder stores 325 scf of natural gas at 2400 psi, each cylinder contains the equivalent of approximately 2.8 gallons of gasoline. Industry "rules of thumb" often cite equivalency factors of 100 scf per gallon of gasoline, implying a significant improvement in energy efficiency for gas. However, there is a lack of good substantiating data to justify the general application of the more optimistic factor.

In general, no changes are required to the SI engine other than replacement of the air cleaner with the gas-air mixer and, perhaps, spark timing advance to partially restore engine power in the gaseous fuel mode. The advance must be limited to avoid significant increases in engine knock and exhaust emissions when operating in the gasoline mode. The California Air Resources Board (CARB) currently does not permit spark advance relative to the vehicle manufacturer's recommendation for gasoline due to unknown impacts on exhaust emissions. However, at least one company intends to obtain CARB approval of a spark advance device for CNG fueled automobiles in the near future.

The steel cylinders are normally located in the car trunk over the wheels because of their size (1.5 cubic feet each) and weight (108 pounds each), and are firmly attached to the vehicle by mounting straps or brackets. Each cylinder has a manual shutoff valve and an automatic safety relief device sensitive to pressure and temperature rises. To prevent accumulation of gas leakage from the manual cylinder refueling valves or the pressure relief devices into the vehicle trunk and the passenger compartment, some type of vapor barrier is generally installed. Discharge of such leakage outside the vehicle body shell leads to rapid dissipation into the atmosphere. Other passive and active venting techniques, such as foam barriers and fans, have been investigated for the trunk and passenger compartments.

Steel cylinders designed to Department of Transportation (DOT) Specification DOT3AA are intended for use in transporting industrial gases, including methane, but are not intended for use with natural gas or potentially corrosive gases. However, 10-inch diameter, 2400 psi operating pressure cylinders are widely used in the U.S. with natural gas. They are substantially heavier than the more highly stressed cylinders made in Italy for vehicle use which do not meet DOT requirements.

Both domestic and foreign CNG kit marketers have been developing lightweight cylinder designs, but such units have seen only limited use to date. Lightweight design approaches for automotive applications, where cost is a major consideration, include the use of aluminum alloys and composite structures.

Aluminum alloys have been used in the fabrication of pressure vessels, but their weight advantage relative to steel is only about 30 percent and costs are higher. Composite pressure vessels, consisting of a metallic inner shell and a layer of reinforcing fibers such as fiberglass or an organic polymer, Kevlar, offer a 50 percent weight reduction potential and other advantages for portable cylinder applications. The shell material may be chosen primarily for compatibility with its contents and the overwrap can bear most of the pressure loads without any weakening from attack by the tank's contents.

The use of hoop windings only for shell reinforcement yields the most easily manufactured and least expensive composite cylinders. For a 325 scf hoop wound cylinder, weight is estimated at 62 pounds (43 percent reduction over steel) and, in mass production, a cost about equal to steel cylinders ($200-300) is projected.

Two gas feed system problem areas that have not yet been completely resolved relate to regulator icing and excess flow shutoff valves. In the former case, despite various heater and other mechanical features incorporated in some regulator system designs, particularly of foreign manufacture, icing problems have been encountered at ambient temperatures even above freezing. Most domestic CNG users either dry the pipeline gas before compression or add a small amount of methanol to the CNG leaving the compressor. With regard to the second problem, an excess flow shutoff valve is intended to prevent complete discharge of the contents of a CNG cylinder in the event of a rupture in the high-pressure line. However, a satisfactory design has not yet been achieved. The principal difficulty is developing a valve which can successfully operate only when needed over the full range of pressures and flow rates experienced in normal vehicle operation.

3.2 LNG SYSTEMS FOR SI ENGINES

A typical LNG system for automotive applications consists of a double-wall cryogenic liquid tank mounted in the trunk, a valve assembly or module for filling, venting and transferring fuel in liquid or vapor form to the engine compartment, a heat exchanger for vaporization and/or heating of the fuel, a low-pressure regulator, a gas-air mixer, fuel switching provisions, and associated low-pressure plumbing, gauges, and support members. It may be supplemented with an optional spark advance device, a gas leakage detector, a compartment isolation membrane, and vents for the vehicle passenger and trunk compartments.

The cryogenic tank is the heart of the LNG system, accounting for most of its volume, weight, cost and operational constraints. It features double-wall construction with the inner shell thermally isolated from the outer shell. The isolation provisions include a high vacuum to minimize thermal conduction and convection, and multilayer super-insulation to minimize radiation between ambient and cold surfaces. Operating tank pressures are usually about 5 to 60 psig. Beech Aircraft Corporation (BAC) claims to have achieved a 14 day standby condition with a totally filled tank without pressure relief.

Domestic tank producers have typically fabricated cylindrical designs with elliptical heads although spherical and oblate spheroid configurations have been used. Tank capacities range from 18 to 70 gallons. The 18 gallon tank was used by BAC in its Pontiac Phoenix demonstration vehicle; it has an outside diameter of 14 inches, a dome-to-dome length of 41 inches and weighs about 70 pounds empty. Materials range from aluminum for both inner and outer walls to combinations of stainless steel inside and aluminum for the outside shell.

Tank operation may be based on either vapor or liquid removal, or a combination of both, utilizing a flow control valve activated by a tank pressure signal. Liquid removal results in less fluctuation of tank pressure.

The principal differences between domestic cryogenic tank designs are the manner of supporting the inner tank from the outer tank and the number of layers of super-insulation used to minimize liquid boiloff. Such features directly affect tank cost and ruggedness, in terms of ability to withstand acceleration loads in a vehicle crash. LNG tanks are decidedly more susceptible to internal damage and penetration than CNG tanks. They should rupture with less violence, but would typically release much more chemical energy.

Two single-fuel LNG automobiles, a Mercury Zephyr and a Pontiac Phoenix, have been displayed recently, both based upon BAC systems. Ford's experimental Zephyr is equipped with a four-cylinder, 2.3-liter engine, with the compression ratio increased to 14 by means of special pistons. Basic spark timing is 20°BTC. The trunk-mounted LNG tank has a liquid capacity of 18 gallons. BAC has installed the same type of LNG system in a 173 cubic inch displacement (CID) engine-equipped 1980 model year Pontiac Phoenix with four-speed manual transmission. With a fully-loaded fuel tank and optimal spark advance, BAC reports a range of 380 miles, or 21.4 miles per gallon of LNG.

3.3 CNG AND LNG FOR CI ENGINES

Associated with the high octane number of methane is a very low cetane number. Therefore, the gas is unsuited for direct use in conventional diesel engines. However, in conjunction with chemical or thermal ignition aids, it can be burned satisfactorily.

Chemical ignition aids can take the form of fuel additives or, alternatively, a "pilot" injection system may be employed. With the pilot system, a secondary injector provides a small amount of high ignition-quality fuel, such as diesel fuel, to the combustion chamber, where it spontaneously ignites and burns the methane in the remainder of the charge. The primary fuel can either be injected or inducted via the intake manifold similar to SI engine practice (fumigation). Thermal ignition aids include spark plugs, glow plugs, or any other hot surface, possibly with a catalytic coating.

Fumigation with diesel fuel is currently favored since it is the easiest approach for a retrofit application. One benefit of fumigation is better mixing of the air and primary fuel than is achieved with injection. Another advantage is the reduction in smoke emissions caused by the predominance of methane, which is highly resistant to soot formation. Since rated diesel power output is usually smoke-limited, a reduction in smoke emissions can improve engine power, up to the knock limit.

A disadvantage of fumigation is the production of higher hydrocarbon (HC) emissions compared to diesel fuel alone. Oxides of nitrogen (NO_x) emissions are lower at part load, but at full load, the overall air-fuel ratio is close to stoichiometric, and there is no longer a NO_x advantage. Emissions of carbon monoxide (CO) tend to be higher; both CO and HC emissions can also increase at low load if the pilot/primary fuel ratio is not adjusted to prevent lean flameout in the bulk air-fuel mixture.

The diesel pilot accounts for 25 to 35 percent of total engine fuel at full power in the case of fumigation but only 5 to 10 percent with direct cylinder injection. As power decreases, the pilot charge makes up an increasing percentage of the total fuel. This variable pilot/gaseous fuel ratio requires a sophisticated control system for optimum fuel utilization. To date, the use of natural gas in diesel engines has been restricted to stationary or marine engines. Since such engines typically operate at constant speed and load for long periods of time, there is little need for such complex automatic controls.

4. CNG AND LNG VEHICLE OPERATING CHARACTERISTICS

Fuel economy, performance and emissions of methane-fueled spark ignition engines depend heavily on the degree to which the engine calibration and hardware have been designed to take advantage of the favorable characteristics of this fuel compared with gasoline. Most available data are not based on optimal systems, and a conclusive assessment of the ultimate potential of methane is difficult at this time.

4.1 FUEL ECONOMY

The use of CNG or LNG in pre-1975 model year vehicles without emission control system modifications has resulted in reported fuel economy improvements of up to 10 percent in passenger cars and up to 20 percent in trucks, relative to vehicle operation with gasoline. These improvements are primarily attributed to the relatively low fuel economy of the baseline gasoline vehicles which generally are calibrated for operation with rich air-fuel mixtures. The fuel economy of late model automobiles operated on methane without modification in spark timing or other emission control system components is approximately equal to the fuel economy obtained with gasoline, when adjusted for differences in fuel heating value. Significant improvements in the fuel economy and power output of CNG and LNG vehicles have been achieved by specific fleet operators by means of spark timing advance and modifications of other emission control equipment. However, such modifications may increase exhaust emissions.

4.2 PERFORMANCE

A number of dual-fuel vehicle fleet operators have reported engine power reductions with methane, ranging from 10 to 20 percent relative to vehicle operation on gasoline. These losses are directly related to the reduction in engine volumetric efficiency, the lean air-fuel mixture calibration, and the use of non-optimum spark advance. In dual-fuel installations, engine power can be restored, at least partially, by means of spark advance and mixture enrichment. However, these calibration adjustments may increase exhaust emissions beyond permissible levels.

In a vehicle designed for methane, the power loss problem may be eliminated by increasing engine compression ratio to about 13:1, advancing spark timing relative to gasoline settings, incorporating a turbocharger, or a combination of these techniques.

4.3 EMISSIONS

Test data provided by several fleet operators indicate large emission reductions with CNG, amounting to 45 to 65 percent for HC, 60 to 80 percent for CO, and 50 to 80 percent for NO_x. These reductions are attributed to two basic factors: (1) unlike gasoline vehicles, CNG-fueled vehicles are generally operated at lean air-fuel mixtures, which is beneficial from an emissions point of view; and (2) the vehicles were older models using relatively rich air-fuel mixtures in the gasoline mode. In late model catalyst-equipped automobiles, use of CNG has resulted in significant reductions in NO_x and CO. While total HC emissions generally increase, the fraction of reactive species declines significantly. In a recent DOE-sponsored test, the fraction of non-methane HC emissions was found to be about 13 percent, in agreement with determinations of the California Air Resources Board. This is particularly encouraging in view of the EPA Notice of Intent for amending vehicle emission standards to permit compliance with a non-methane hydrocarbon standard (46 FR 21628; April 13, 1981).

5. SAFETY

The safety of CNG and LNG vehicle systems remains an important issue that has not yet been completely resolved. Only a few non-collision related incidents have been reported in which the natural gas system was identified as the source of a fire, attributed to faulty installation or venting deficiencies. However, the mileage that has been accumulated by methane vehicles is low compared to gasoline. Since accident-related, gasoline-fueled automobile fires occur at a rate of only about one per 100 million vehicle miles, the fact that none has been encountered with methane is not statistically significant. Also, the excellent safety record compiled in Italy on CNG cannot be confidently extrapolated to U.S. usage inasmuch as cylinder designs, safety devices and administrative procedures differ considerably between the two countries. In the testing area, a safety impact test program conducted in 1971 for DOT included barrier crash tests of CNG dual-fuel vehicles, drop tests of CNG cylinders, and sled tests of CNG and LNG storage tank restraining systems. However, the vehicles, fuel systems and test conditions were not representative of current design practices.

The major safety concerns associated with methane-fueled vehicles under normal operating conditions are fuel leakage, boiloff of LNG vapor, and corrosive failure of CNG cylinders due to excessive concentrations of hydrogen sulfide (H_2S) in natural gas. A number of specific design steps can be employed to control these hazards, including isolation of fuel system components, venting of the passenger compartment and/or the space used for fuel storage, and the use of odorants and gas-sensing devices. Potential problems related to system corrosion may be eliminated by maintaining quality control of the fuel supply.

The hazards associated with methane vehicles under accident conditions include fuel release upon impact, tank rupture due to fire, and intrusion of fuel storage components into the passenger compartment. Lightweight CNG tanks of filament reinforced materials appear to be more susceptible to impact damage and require confirmation of crash integrity.

One area of concern is that there are no industry-wide standards regarding the design, manufacture, installation and performance of CNG fuel systems although efforts are underway, notably within the American Gas Association, to develop such standards. Standards are particularly important because methane systems are currently installed as aftermarket kits and are therefore not integrated in the original vehicle safety design and testing.

6. CNG FUELING

In the current absence of public fueling facilities for CNG cylinders, it is necessary that fleet operators install fueling systems for their vehicles. Two types of filling designs are used, termed fast fill and time fill systems. An installation may consist of time fill only, fast fill only, or both.

In the fast fill system, natural gas from a utility pipeline is routed through a dehydrating bed and a particulate filter into the compressor suction line. For the usual vehicle cylinder storage pressure of 2400 psi, the compressor discharges the gas at approximately 3600 psi into a bank of high pressure cylinders. The compressor discharge is equipped with a high pressure gauge and relief valve. The vehicle filling manifold at the storage bank outlet is comprised of fill-vent valves, flexible hoses and self-sealing quick disconnect couplings. The couplings on the filling manifold mate with couplings on the vehicles. When the fill-vent valve is closed after vehicle filling, the gas in the hose is vented about ten feet above the ground remote from the operator. To achieve a full charge, the final pressure in the vehicle cylinders is varied depending upon ambient temperature; the pressure can be controlled manually or by use of a temperature compensating regulator. A vehicle can usually be filled in three to five minutes.

The time fill system is essentially the same as the fast fill installation except the bank of high pressure storage cylinders is not required. Also, the gas from the compressor is reduced in pressure to near the final filling value for the ambient temperature. Time filling is customarily accomplished overnight.

7. METHANE SUPPLY

The United States has sufficient proved and potential gas reserves, plus a synthetic natural gas (SNG) resource base, to support consumption near or above current levels through the rest of this century. However, to achieve these required production quantities, it will be necessary in future years to recover gas from more inaccessible formations and more hostile environments. In addition, conversion of coal and, perhaps, biomass and waste resources will have to be initiated.

Actual gas supply is dependent upon government policies, technological advancements, economic incentives, and capital availability. Due to these uncertainties, published gas supply projections for the next two decades vary widely. DOE's 1980 Annual Report to Congress forecasts declining gas production from the lower 48 states, balanced in part by nearly one trillion cubic feet per year of Alaskan gas becoming available in the 1985-86 time period. An important area of uncertainty is the future contribution of imported gas. Among six published projections for 1990, import estimates range from 1 to 4.3 trillion cubic feet annually, with the DOE estimate near the low end. To provide sufficient quantities of gas to meet projected demands, the DOE forecast relies heavily on gas produced from unconventional sources, particularly from Western tight sand reservoirs. The DOE forecast assumes that demand is constrained by conservation and restrictions in use, and concludes that more gas could be supplied if needed.

If gas for automotive use is confined to fleet applications, additional demand should be within the capability of the supply system to accommodate. Although occasional local and seasonal supply shortages may occur, as in the past, such events will be due primarily to storage and transmission system deficiencies rather than increased gas demand for vehicular use.

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